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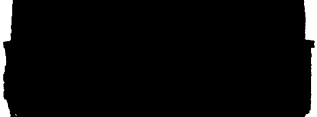

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PROCEEDINGS

OF

THE METEOROLOGICAL SOCIETY.

EDITED BY

JAMES GLAISHER, F.R.S.

VOL. IV.

1867, NOVEMBER 20, TO 1869, JUNE 16.

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Vol. IV.] [No. 33.

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OF

THE METEOROLOGICAL SOCIETY.

EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

1867, NOVEMBER 20.

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Vol. IV. 1867, NOVEMBER 20. [No. 33.

JAMES GLAISHER, Esq., F.R.S., &c., President, in the Chair.

Rev C. H. Griffith, M.A., The Rectory, Strathfield Turgiss, Winchfield, Hants;

William J. Harris, Esq., M.R.C.S. Eng., Worthing, Sussex;

Henry John Mann, Esq., Paradise Villa, Green Lane, Stoke Newington;

William Salmon, Esq., R.N., Meteorological Office, 2 Parliament Street, S.W.;

were balloted for and duly elected Fellows of the Society.

I. *On the Hourly Frequency and Fall of Rain, in connexion with the Diurnal changes of Magnetic Declination.* By James Glaisher, Esq., F.R.S., F.R.A.S.

[Plates I. & II.]

Mr. Baxendell, of Manchester, published, in the 'Proceedings of the Manchester Literary and Philosophical Society,' in its series 1865–66, a paper "On the Fall of Rain during the different hours of the day, as deduced from a series of Observations made by the Rev. J. C. Bates at St. Martin's Parsonage, Castleton Moor," an abstract of which was published in our Proceedings, vol. iii. p. 135, paper xxviii., under "Books and Notices."

These observations were made by a rain-gauge, or rather by ninety-six small rain-gauges placed in a circle and moved by clockwork, so that each gauge received the rainfall during the space of one-quarter of an hour each day: the whole period over which these observations extended was a little more than eight months.

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From the diurnal curve of rainfall and frequency deduced by Mr. Baxendell from these observations, he did not find any connexion with the curve of day temperature, nor, indeed, with any other meteorological phenomena; but he found a close resemblance between it and that of magnetic declination, and he also found that this agreement held good whether he used the results from partial as well as from the whole period of observations. It was this general agreement, by dividing so short a period of observations as eight months into two groups of four or even smaller, that gave great weight to Mr. Baxendell's deductions; and it became a matter of great interest to include the observations of other years in the inquiry.

At the Royal Observatory, Greenwich, the rainfall has been continuously registered for many years by a gauge attached to Osler's anemometer, and recorded, simultaneously with the direction and the strength of the wind, on the same sheet, which has enabled us to extract the amount of rain which falls during any period, together with the rapidity of the fall.

I resolved to extract from these sheets the fall of rain in every hour from the beginning of the year 1861 to the end of last year, or for a period of six years.

The first step was to extract the fall of rain in every hour in every day.

The next step was to take the amount of rain which had fallen in every hour during the month.

The third step was the forming these results into two Tables in every year, the one showing in each year the total amount fallen in every hour in each month, and the other in each year the number of times rain had fallen in every hour in each month; and in this way the following series of Tables were formed. The rain-gauge at the anemometer is placed 50 feet above the ground: the mean yearly fall of rain at this elevation for these six years was 14·25 inches, and the mean fall on the ground for the same six years was 23·7 inches; these numbers are related in the ratio of 6 : 10, and, consequently, all amounts of rain as registered in these six years will be converted into the fall on the ground by multiplying the fall at the anemometer by 10, and dividing the product by 6, or by moving the decimal point of the fall at the anemometer one place to the right and dividing by 6. The frequency of rain is the same at both elevations; and, therefore, the numbers in these Tables apply equally to observations on the ground.

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TABLE I. Showing the Number of Times Rain fell during every Hour in every Month.

1861. Month.	Between what Hours.																							Total Number of times of Rain-fall in the Month.
	0^h to 1^h.	1^h to 2^h.	2^h to 3^h.	3^h to 4^h.	4^h to 5^h.	5^h to 6^h.	6^h to 7^h.	7^h to 8^h.	8^h to 9^h.	9^h to 10^h.	10^h to 11^h.	11^h to 12^h.	12^h to 13^h.	13^h to 14^h.	14^h to 15^h.	15^h to 16^h.	16^h to 17^h.	17^h to 18^h.	18^h to 19^h.	19^h to 20^h.	20^h to 21^h.	21^h to 22^h.	22^h to 23^h.	23^h to 24^h.	
January	1	1	1	2	1	1	1	1	1	1	1	1	1	1	3	1	...	1	...	1	1	...	...	1	23
February ...	4	4	5	4	3	2	...	1	1	2	2	5	1	2	2	2	3	3	4	3	4	4	4	3	68
March.....	1	3	3	3	3	4	4	3	3	3	1	2	2	4	5	3	5	7	6	4	6	5	...	2	82
April	2	2	1	1	1	2	1	1	1	...	...	...	1	2	2	...	2	2	3	2	2	1	1	1	31
May	2	1	1	2	1	...	1	2	3	...	...	2	3	2	1	2	2	1	2	1	1	2	2	1	35
June	2	5	4	5	3	3	3	3	2	1	1	...	...	...	...	1	1	1	1	1	2	3	1	2	45
July	...	2	3	3	3	3	2	2	2	4	5	4	2	2	1	2	3	2	...	...	1	2	2	3	53
August	4	2	1	2	2	1	...	...	...	...	1	1	...	...	...	...	...	1	2	...	...	1	2	3	23
September ...	3	3	3	4	4	2	3	2	3	...	2	2	3	4	2	2	1	2	1	1	...	2	...	2	51
October	2	2	3	3	2	1	...	1	2	1	1	...	2	1	1	1	1	2	2	1	3	1	...	3	36
November ...	6	5	5	3	4	4	4	3	3	2	1	2	2	3	2	2	3	3	3	4	4	6	5	6	85
December ...	1	1	2	2	2	2	1	...	...	1	1	1	4	4	3	4	1	1	1	1	1	1	...	1	36
Sums	28	31	32	34	29	25	20	19	21	15	16	20	21	25	22	20	22	26	25	19	25	28	17	28	568

No rain fell in four hours in January, in one hour in February, one in March, four in April, three in May, four in June, three in July, eleven in August, three in September, and three in December—or thirty-seven times during the year.

The hour in which rain fell most frequently was from 17^h to 18^h in March, being seven in number; it fell six times in five cases, viz. between 18^h and 19^h and 20^h to 21^h in March, in November from 0^h to 1^h, 20^h to 21^h, and 23^h to 24^h. There are eleven instances of falling five times, viz. two in February, three in March, two in June, one in July, and three in November; and there are twenty-six instances in which it has fallen four times in the month within the hour.

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TABLE II. Showing the Number of Times Rain fell during every Hour in every Month.

1862. Month.	Between what Hours.																							Total Number of times of Rain-fall in the Month.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
January	2	3	2	1	1	3	2	3	2	2	...	...	1	...	1	2	3	2	4	5	4	3	4	5	55
February ...	2	1	2	1	1	1	1	1	...	...	...	...	...	...	...	...	1	1	1	1	1	1	1	2	19
March	5	4	7	6	5	6	2	1	5	5	4	5	6	4	3	5	5	7	6	4	4	3	3	4	109
April	3	2	3	2	1	1	1	2	2	2	2	2	3	4	4	4	3	3	5	5	6	4	1	3	68
May	5	5	3	3	3	3	3	4	4	3	2	2	3	2	3	3	4	5	2	1	2	3	3	4	75
June	4	2	3	6	5	5	6	4	3	4	4	3	4	1	...	1	1	1	1	...	1	1	2	3	65
July	3	3	3	1	2	2	3	4	3	1	1	1	1	2	2	5	2	2	3	2	1	1	2	3	53
August	5	5	6	4	3	5	2	3	3	3	3	3	1	2	3	2	1	2	2	3	3	1	1	3	69
September ...	1	3	3	4	5	4	3	2	3	5	5	3	4	3	1	3	4	3	5	5	4	2	1	1	77
October	2	4	6	7	6	5	6	5	4	3	5	4	4	3	2	2	3	3	4	6	6	5	2	4	101
November ...	3	2	2	2	4	3	2	2	2	...	...	...	1	3	2	2	2	3	2	2	1	1	3	2	46
December ...	3	6	7	7	7	2	2	3	1	2	1	3	2	3	3	3	2	1	3	3	1	2	2	3	72
Sums	38	40	47	44	43	40	33	34	32	30	27	26	30	27	24	32	31	33	38	37	34	27	25	37	809

In January there were three hours in which no rain fell, in February eight, in June two, and in November three—or sixteen times during the year.

The hours in which rain fell most frequently was from 2h to 3h and from 17h to 18h in March, from 3h to 4h in October, and from 2h to 3h, 3h to 4h, and 4h to 5h in December, being seven in number. There are fourteen instances of falling six times, viz. four in March, one in April, two in June, one in August, five in October, and one in December; and there are twenty-nine instances in which the number amounts to five times in the above Table.

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TABLE III. Showing the Number of Times Rain fell during every Hour in every Month.

1863. Month.	Between what Hours.																								Total Number of Times of Rain-fall in the Month.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
January	2	1	2	1	1	2	3	4	3	3	4	5	4	2	2	5	3	3	6	5	2	2	3	2	70
February	1	1	1	2	1	...	...	...	1	...	...	...	...	1	2	1	1	3	1	2	2	1	2	...	23
March	...	2	2	3	4	2	4	2	2	2	2	2	1	...	...	...	1	...	...	...	1	...	...	...	30
April	1	1	3	4	2	1	1	1	...	...	...	...	1	2	2	1	...	...	...	...	...	...	...	1	21
May	2	...	...	...	2	3	2	1	...	1	1	2	2	2	2	3	2	2	1	3	3	2	2	1	39
June	2	3	5	6	4	3	4	5	5	5	2	2	5	3	3	4	3	4	3	4	2	1	1	1	80
July	...	1	1	1	1	2	2	3	2	1	...	...	...	...	...	...	...	...	1	1	1	...	...	1	18
August	1	1	2	3	3	2	2	2	3	3	1	1	...	...	1	1	1	2	3	2	1	1	1	1	38
September	4	3	1	3	4	4	3	3	2	2	3	4	5	5	5	5	4	2	3	3	3	2	6	5	84
October	3	5	6	7	4	2	2	...	...	...	1	1	2	4	3	2	2	1	3	3	3	2	2	2	60
November	4	3	2	...	1	1	1	2	1	1	1	1	1	1	2	2	1	...	2	2	2	2	4	4	41
December	...	1	2	2	1	1	...	1	1	1	1	2	1	...	...	2	2	2	3	4	4	2	...	...	33
Sums	20	22	27	32	28	23	24	24	20	19	16	20	22	20	22	26	20	19	26	29	24	15	21	18	537

In February there were eight hours in which no rain fell, in March ten, in April eleven, in May four, in July eleven, in August two, in October three, in November two, and in December six—or fifty-seven times during the year.

The hour in which rain fell most frequently was in October from 3^h to 4^h, being seven in number; it fell six times in four instances, viz. from 18^h to 19^h in January, 3^h to 4^h in June, 22^h to 23^h in September, and from 2^h to 3^h in October. There are fourteen instances of falling five times, and there are twenty-three instances in which the number amounts to four times during the hour in the above Table.

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TABLE IV. Showing the Number of Times Rain fell during every Hour in every Month.

1864. Month.	Between what Hours.																								Total Number of Times of Rain-fall in the Month.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
January	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2	3	3	2	3	3	2	2	2	38
February	2	1	1	1	...	1	1	1	1	...	...	...	1	1	...	...	...	1	1	1	2	3	1	1	21
March	6	5	4	3	4	3	3	2	2	3	4	3	3	3	4	2	3	2	4	3	2	2	5	4	79
April	2	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1	...	1	1	29
May	1	2	2	1	1	3	2	2	2	3	5	5	4	3	3	3	1	1	2	2	2	2	1	1	54
June	4	4	5	5	5	5	3	2	4	4	3	2	2	2	2	2	3	3	2	1	1	1	2	2	69
July	2	2	1	1	1	1	1	...	...	1	1	1	1	1	...	...	...	1	1	1	1	1	...	...	19
August	4	4	3	2	1	...	...	...	...	...	...	...	1	1	1	1	1	1	1	1	1	1	3	4	31
September	3	3	3	3	3	4	3	3	2	2	3	5	3	3	3	5	6	2	1	1	1	1	2	2	67
October	...	...	...	...	...	1	...	...	1	1	1	1	2	1	2	1	3	3	1	...	1	1	...	...	20
November	1	1	1	1	2	3	5	5	6	4	2	1	3	2	5	3	3	3	2	...	2	2	...	1	58
December	2	2	3	2	2	1	1	1	1	...	...	...	...	1	...	1	1	...	...	...	1	1	2	2	24
Sums	28	26	25	21	21	24	21	18	22	20	21	20	22	21	23	22	26	22	18	14	18	17	19	20	509

In February there were seven hours in which no rain fell, in April one, in July seven, in August seven, in October ten, in November two, and in December eight—or forty-two times during the year.

The hours in which rain fell most frequently was from 0h to 1h in March, 16h to 17h in September, and from 8h to 9h in November, when the number was six. There are thirteen instances in which rain fell five times during the hour, and sixteen instances in which the number amounted to four.

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TABLE V. Showing the Number of Times Rain fell during every Hour in every Month.

1865. Month.	Between what Hours.																							Total Number of Times of Rain-fall in the Month.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
January	3	1	2	2	1	2	4	2	4	4	3	4	6	4	2	1	4	3	3	4	4	4	1	2	70
February	4	2	4	1	1	3	3	...	1	1	...	1	2	3	3	2	3	2	2	1	1	1	2	3	46
March	...	...	1	1	1	1	...	...	...	1	1	1	1	1	2	1	2	1	1	2	1	1	...	...	20
April	...	2	2	...	...	...	...	...	...	...	...	...	...	...	2	1	...	...	...	...	...	...	...	...	7
May	4	5	1	3	2	2	2	1	1	1	1	...	1	2	2	2	3	3	3	5	4	1	2	1	52
June	...	1	1	1	1	1	2	4	3	4	2	2	1	1	2	2	2	...	...	...	...	...	...	...	30
July	1	1	...	1	1	3	2	2	2	2	2	4	3	1	2	4	4	2	2	2	1	...	1	1	44
August	2	5	1	2	4	4	2	1	3	4	3	1	2	2	1	...	1	3	2	3	5	4	1	3	59
September	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
October	3	1	4	4	3	3	4	4	4	5	5	4	3	3	1	1	3	3	4	4	4	4	...	1	75
November	...	...	1	1	1	3	3	1	2	3	...	1	3	2	2	2	1	2	1	2	1	2	3	2	39
December	1	...	1	...	...	1	1	2	1	2	2	1	1	1	3	2	3	2	1	2	1	...	1	...	29
Sums	18	18	18	16	15	23	23	17	21	27	19	19	23	20	22	18	26	21	19	25	22	17	11	13	471

In February there were two hours in which no rain fell, seven in March, twenty in April, one in May, eight in June, two in July, one in August, twenty-four in September, one in October, three in November, and five in December—or seventy-four times during the year. In September there was no rainfall throughout the month, which is a remarkable contrast to the succeeding year, when it fell the greatest number of times (with the exception of February) throughout the twelve months.

The hour in which rain fell most frequently was from 12^h to 13^h in January, when it fell six times; there were six instances of the falls amounting to five within the hour, and thirty-two instances of four times.

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TABLE VI. Showing the Number of Times Rain fell during every Hour in every Month.

1866. Month.	Between what Hours.																								Total Number of Times of Rain-fall in the Month.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
January	5	4	2	3	2	1	1	1	1	1	1	4	3	5	4	1	1	3	7	4	4	5	6	5	74
February ...	4	7	5	3	1	2	2	2	3	4	7	5	4	1	2	3	2	3	5	4	6	7	4	2	88
March	1	2	2	1	1	3	1	2	2	3	3	2	4	2	1	2	1	1	1	2	1	1	2	...	41
April	3	4	7	8	7	2	3	4	2	2	3	4	2	1	1	1	...	1	2	3	2	1	...	3	66
May	1	1	1	...	2	1	2	...	2	1	1	2	2	5	4	2	2	1	1	2	1	1	1	1	37
June	1	1	2	1	1	...	1	4	3	2	4	3	5	3	3	4	4	2	...	1	3	3	2	1	54
July	2	2	2	...	...	...	1	...	1	2	1	1	...	...	1	1	1	...	...	...	...	...	...	3	18
August	2	3	2	2	2	1	...	...	...	1	1	2	2	3	2	2	4	3	2	3	5	2	1	1	46
September ...	4	4	4	4	3	2	2	2	4	2	1	1	2	3	4	5	5	3	4	6	2	4	2	2	75
October	3	2	3	3	3	3	3	3	3	2	1	1	1	...	1	1	2	1	2	3	2	2	2	3	50
November ...	4	3	4	3	3	2	2	2	...	2	2	3	1	1	2	1	3	3	1	...	...	1	1	1	45
December ...	2	4	5	2	2	2	2	2	4	3	5	5	4	4	3	2	2	3	2	3	2	4	3	4	74
Sums	32	37	39	30	27	19	20	22	25	25	30	33	30	28	28	25	27	24	27	31	28	31	24	26	668

In March there was one hour in which no rain fell, two in April, two in May, two in June, twelve in July, three in August, one in October, and three in November—or twenty-six times during the year.

The hour in which rain fell most frequently was from 3h to 4h in April, when the number of times was eight; there are six instances in which it amounted to seven times, viz. in January one, in February three, and in April two. There are three instances in which it fell six times, fourteen instances of five, and thirty-six instances when it amounted to four times.

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TABLE VII. Showing the Total Monthly amount of Rain which fell during every Hour at the height of 50 feet above the ground.

1861. Month.	Between what Hours.																							Fall of Rain in Month.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	·001	·014	·012	·003	·002	·003	·004	·003	·005	·004	·005	·002	·002	·010	·012	·010	.....	·001	.....	·001	·012	.....	.....	·001	0·107
February ...	·019	·019	·085	·041	·007	·050	.....	·003	·039	·046	·037	·030	·020	·006	·026	·033	·115	·073	·047	·038	·147	·083	·045	·026	1·035
March.....	·167	·054	·055	·070	·085	·094	·032	·037	·012	·007	·001	·011	·018	·026	·067	·030	·038	·072	·130	·068	·042	·047	.....	·054	1·217
April	·097	·046	·030	·020	·006	·024	·006	·030	·003	.....	.....	.....	·001	·006	·004	.....	·069	·060	·015	·015	·020	·040	·082	·120	0·694
May	·009	·002	·001	·009	·002	.....	·020	·283	·051	.....	.....	·046	·055	·076	·005	·009	·020	·008	·089	·140	·070	·157	·034	·003	1·089
June	·123	·147	·060	·080	·111	·098	·015	·096	·038	·010	·006	.....	.....	.....	.....	·018	·015	·045	·054	·004	·032	·134	·030	·023	1·139
July	.....	·148	·148	·128	·022	·024	·014	·009	·008	·202	·245	·241	·042	·119	·033	·020	·076	·011	.....	.....	·043	·068	·063	·034	1·638
August	·038	·004	·001	·002	·039	·002	.....	.....	.....	.....	·010	·002	.....	.....	.....	.....	.....	·025	·009	.....	.....	·014	·066	·112	0·324
September ...	·017	·103	·040	·086	·227	·027	·097	·067	·010	.....	·009	·035	·055	·083	·060	·023	·009	·038	·013	·005	.....	·020	.....	·017	1·041
October	·004	·009	·211	·092	·012	·007	.....	·002	·065	·021	·002	.....	·041	·083	·010	·015	·010	·021	·011	·004	·018	·023	.....	·113	0·774
November ...	·246	·380	·337	·262	·205	·181	·089	·069	·078	·019	·014	·034	·007	·051	·060	·083	·077	·152	·150	·084	·068	·079	·120	·166	3·011
December ...	·002	·023	·056	·076	·038	·031	·001	.....	.....	·010	·004	·034	·161	·105	·056	·101	·030	·060	·050	·025	·008	·003	.....	·004	0·878
Sums	·723	·949	1·036	·869	·756	·541	·278	·599	·309	·319	·333	·435	·402	·565	·333	·342	·459	·566	·568	·384	·460	·608	·440	·673	12·947

The total yearly amount of rain which fell during every hour is shown by the number at the foot of the Table; the greatest of these is 1·036 inch, between 2h and 3h, and the smallest number, ·278 inch, between the hours of 6 and 7.

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TABLE VIII. Showing the Total Monthly amount of Rain which fell during every Hour at the height of 50 feet above the ground.

1862. Month.	Between what Hours.																							Fall of Rain in Month.
	0^h to 1^h.	1^h to 2^h.	2^h to 3^h.	3^h to 4^h.	4^h to 5^h.	5^h to 6^h.	6^h to 7^h.	7^h to 8^h.	8^h to 9^h.	9^h to 10^h.	10^h to 11^h.	11^h to 12^h.	12^h to 13^h.	13^h to 14^h.	14^h to 15^h.	15^h to 16^h.	16^h to 17^h.	17^h to 18^h.	18^h to 19^h.	19^h to 20^h.	20^h to 21^h.	21^h to 22^h.	22^h to 23^h.	23^h to 24^h.	
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	·008	·021	·095	·082	·035	·037	·023	·033	·025	·013	.....	.....	·008	.....	·015	·071	·036	·043	·084	·179	·120	·093	·013	·009	1·043
February ...	·018	·012	·007	·006	·024	·020	·040	·018	.....	.....	.....	.....	.....	.....	.....	.....	·008	·020	·010	·024	·025	·006	·005	·023	0·266
March.....	·227	·090	·120	·094	·070	·081	·023	·020	·077	·110	·110	·235	·112	·046	·111	·081	·022	·081	·095	·063	·049	·023	·066	·079	2·085
April	·034	·020	·022	·035	·023	·020	·010	·071	·012	·104	·110	·039	·112	·055	·080	·128	·164	·188	·174	·122	·093	·025	·004	·008	1·653
May	·096	·214	·047	·030	·033	·105	·077	·103	·083	·028	·024	·094	·085	·055	·043	·199	·060	·108	·162	·050	·012	·014	·091	·069	1·882
June	·148	·043	·098	·098	·096	·142	·118	·191	·045	·084	·031	·046	·040	·003	.....	·013	·009	·016	·002	.....	·003	·020	·037	·054	1·337
July	·082	·082	·037	·027	·162	·025	·059	·151	·045	·014	·006	·012	·005	·038	·147	·106	·053	·048	·013	·006	·003	·008	·003	·014	1·146
August	·062	·124	·161	·185	·046	·023	·006	·056	·044	·071	·061	·020	·013	·020	·233	·202	·125	·054	·023	·087	·103	·024	·010	·024	1·777
September ...	·010	·068	·096	·040	·033	·032	·025	·070	·078	·083	·048	·101	·114	·009	·001	·015	·044	·037	·120	·188	·067	·043	·002	·001	1·325
October	·081	·099	·233	·317	·124	·044	·149	·056	·063	·110	·121	·079	·023	·008	·012	·125	·117	·054	·113	·288	·182	·139	·010	·165	2·712
November ...	·084	·027	·022	·020	·066	·048	·010	·011	·005	.....	.....	.....	·018	·016	·019	·015	·005	·078	·035	·050	·025	·050	·034	·023	0·691
December ...	·041	·031	·064	·046	·079	·002	·041	·034	·020	·008	·002	·031	·092	·068	·052	·102	·031	·002	·006	·008	·002	·022	·049	·103	0·936
Sums	·891	·831	1·002	·980	·791	·579	·581	·814	·497	·625	·513	·657	·622	·318	·713	1·057	·704	·729	·837	1·065	·684	·467	·324	·572	16·853

The total yearly amount of rain which fell during every hour is shown by the numbers at the foot of the Table; the greatest of these is 1·065 inch, between 19^h and 20^h, and the smallest is 0·318, between the hours of 13 and 14.

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TABLE IX. Showing the Total Monthly amount of Rain which fell during every Hour at the height of 50 feet above the ground.

1863. Month.	Between what Hours.																							Fall of Rain in Month.
	0^h to 1^h.	1^h to 2^h.	2^h to 3^h.	3^h to 4^h.	4^h to 5^h.	5^h to 6^h.	6^h to 7^h.	7^h to 8^h.	8^h to 9^h.	9^h to 10^h.	10^h to 11^h.	11^h to 12^h.	12^h to 13^h.	13^h to 14^h.	14^h to 15^h.	15^h to 16^h.	16^h to 17^h.	17^h to 18^h.	18^h to 19^h.	19^h to 20^h.	20^h to 21^h.	21^h to 22^h.	22^h to 23^h.	23^h to 24^h.	
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	·006	·002	·004	·001	·003	·017	·093	·083	·043	·042	·041	·045	·030	·022	·006	·061	·105	·074	·141	·176	·125	·014	·043	·004	1·181
February	·005	·007	·020	·011	·005	.....	.....	.....	·003	.....	.....	.....	.....	·015	·013	·012	·031	·114	·070	·032	·025	·018	·013	.....	0·394
March	.....	·023	·013	·120	·043	·025	·055	·047	·038	·036	·040	·016	·003	.....	.....	.....	·005	.....	.....	.....	·004	.....	.....	.....	0·468
April	·006	·020	·073	·022	·031	·007	·003	·003	.....	.....	.....	.....	·002	·020	·008	·004	.....	.....	.....	.....	.....	.....	.....	·005	0·204
May	·009	.....	.....	.....	·072	·074	·025	·012	.....	·004	·030	·018	·009	·030	·034	·011	·056	·053	·014	·053	·020	·011	·026	·010	0·571
June	·042	·043	·108	·120	·040	·084	·031	·052	·217	·038	·146	·060	·085	·121	·065	·141	·289	·454	·271	·078	·310	·072	·003	·008	2·878
July	.....	·016	·009	·022	·044	·047	·110	·088	·070	·004	.....	.....	.....	.....	.....	.....	.....	.....	·025	·072	·013	.....	.....	·120	0·640
August	·004	·007	·049	·098	·266	·058	·041	·031	·082	·151	·150	·003	.....	.....	·010	·004	·030	·049	·080	·052	·006	·013	·005	·002	1·191
September	·051	·036	·087	·060	·075	·018	·042	·045	·035	·043	·145	·263	·221	·343	·214	·107	·049	·048	·008	·054	·069	·077	·072	·088	2·250
October	·016	·103	·155	·096	·035	·048	·024	.....	.....	.....	·010	·008	·012	·063	·105	·016	·028	·012	·011	·009	·014	·051	·024	·021	0·861
November	·056	·012	·002	.....	·017	·072	·002	·003	·003	·006	·003	·004	·022	·046	·047	·042	·030	.....	·070	·160	·069	·069	·056	·102	0·893
December	.....	·008	·098	·021	·002	·002	.....	·004	·013	·026	·016	·018	·003	.....	.....	·040	·029	·145	·055	·063	·024	·005	.....	.....	0·572
Sums	·195	·277	·618	·571	·633	·452	·426	·368	·504	·350	·581	·435	·387	·660	·502	·438	·652	·949	·745	·749	·679	·330	·242	·360	12·103

The total yearly amount of rain which fell during every hour is shown by the numbers at the foot of the Table; the greatest of these is 0·949 inch, between 17^h and 18^h, and the smallest is 0·195, between the hours of 0 and 1.

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TABLE X. Showing the Total Monthly amount of Rain which fell during every Hour at the height of 50 feet above the ground.

1864. Month.	Between what Hours.																								Fall of Rain in Month.
	0^h to 1^h.	1^h to 2^h.	2^h to 3^h.	3^h to 4^h.	4^h to 5^h.	5^h to 6^h.	6^h to 7^h.	7^h to 8^h.	8^h to 9^h.	9^h to 10^h.	10^h to 11^h.	11^h to 12^h.	12^h to 13^h.	13^h to 14^h.	14^h to 15^h.	15^h to 16^h.	16^h to 17^h.	17^h to 18^h.	18^h to 19^h.	19^h to 20^h.	20^h to 21^h.	21^h to 22^h.	22^h to 23^h.	23^h to 24^h.	
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	·001	·001	·001	·001	·001	·001	·001	·011	·007	·030	·005	·029	·030	·006	·006	·028	·016	·017	·030	·028	·064	·085	·063	·005	0·467
February	·046	·004	·003	·003	.....	·006	·003	·002	·001	.....	.....	.....	·015	·003	.....	.....	.....	·018	·028	·030	·036	·063	·010	·026	0·297
March	·045	·035	·019	·012	·040	·006	·028	·008	·073	·109	·090	·118	·091	·045	·044	·026	·095	·069	·087	·105	·083	·026	·032	·037	1·323
April	·040	·005	·010	·016	·030	·042	·021	·031	·004	·003	.....	·006	·007	·033	·050	·043	·037	·033	·003	·020	·028	.....	·035	·048	0·545
May	·020	·041	·096	·081	·035	·040	·039	·028	·008	·038	·068	·108	·104	·236	·102	·197	·006	·010	·032	·027	·018	·043	·010	·020	1·407
June	·068	·062	·036	·038	·035	·014	·005	·010	·047	·013	·005	·005	·020	·020	·020	·012	·027	·043	·017	·022	·026	·025	·006	·004	0·580
July	·025	·002	·001	·001	·001	·001	·001	.....	.....	·005	·037	·001	·001	·002	.....	.....	.....	·021	·048	·026	·004	·001	.....	.....	0·178
August	·072	·029	·101	·014	·002	.....	.....	.....	.....	.....	.....	.....	·010	·007	·004	·035	·023	·035	·015	·004	·010	·018	·071	·037	0·487
September	·010	·003	·003	·011	·032	·092	·022	·039	·017	·050	·064	·114	·111	·336	·080	·219	·454	·046	·004	·071	·040	·203	·069	·011	2·101
October	.....	.....	.....	.....	.....	·011	.....	.....	·015	·020	.032	·055	·049	·072	·040	·004	·057	·198	·140	.....	·044	·005	.....	.....	0·742
November	·002	·002	·002	·002	·053	·019	·137	·110	·196	·114	·070	·055	·157	·140	·113	·058	·108	·069	·010	.....	·035	·065	.....	·005	1·522
December	·007	·014	·014	·003	·008	·035	·008	·013	·012	.....	.....	.....	.....	·003	.....	·047	·004	.....	.....	.....	·003	·017	·009	·045	0·242
Sums	·336	·198	·286	·182	·237	·267	·265	·252	·380	·382	·371	·491	·595	·903	·459	·669	·827	·559	·414	·333	·391	·551	·305	·238	9·891

The total yearly amount of rain which fell during every hour is shown by the numbers at the foot of the Table; the greatest of these is 0·903 inch, between 13^h and 14^h, and the smallest is 0·182, between the hours of 3 and 4.

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TABLE XI. Showing the Total Monthly amount of Rain which fell during every Hour at the height of 50 feet above the ground.

1865. Month.	Between what Hours.																								Fall of Rain in Month.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	·053	·002	·025	·091	·037	·025	·059	·055	·038	·082	·121	·214	·287	·155	·111	·019	·045	·036	·038	·032	·062	·095	·022	·030	1·734
February	·118	·082	·028	·010	·004	·017	·056	.....	·050	·035	.....	·055	·057	·059	·016	·014	·010	·011	·003	·010	·022	·034	·028	·053	0·772
March	.....	.....	·020	·021	·006	·007	.....	.....	.....	·003	·005	·010	·030	·030	·022	·014	·021	·014	·019	·022	·023	·010	.....	.....	0·277
April	.....	·087	·040	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	·094	·012	.....	.....	.....	.....	.....	.....	.....	.....	0·233
May	·076	·070	·001	·201	1·020	·025	·055	·005	·020	·035	·002	.....	·025	·062	·044	·450	·117	·268	·174	·448	·166	·045	·072	·025	3·406
June	.....	·430	·115	·010	·002	·090	·076	·173	·231	·221	·052	·078	·140	·080	·102	·090	·082	.....	.....	.....	.....	.....	.....	.....	1·972
July	·015	·080	.....	·025	·144	·146	·199	·169	·111	·060	·061	·091	·042	·017	·019	·509	·083	·037	·040	·012	·001	.....	·003	·010	1·874
August	·140	·082	·130	·400	·376	·394	·052	·020	·137	·302	·035	·020	·051	·077	·005	.....	·005	·148	·138	·078	·106	·065	·110	·154	3·025
September	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
October	·066	·030	·189	·135	·130	·220	·143	·092	·048	·210	·114	·120	·084	·037	·020	·010	·160	·193	·092	·105	·103	·233	.....	·040	2·574
November	.....	.....	·005	·112	·032	·060	·066	·010	·034	·029	.....	·010	·069	·029	·030	·020	·010	·015	·007	·013	·014	·052	·031	·083	0·731
December	·005	.....	·010	.....	.....	·010	·005	·012	·020	·023	·038	·012	·023	·020	·018	·014	·019	·009	·006	·022	·002	.....	·004	.....	0·272
Sums	·473	·863	·563	1·005	1·751	·994	·711	·536	·689	1·000	·428	·610	·808	·566	·481	1·152	·552	·731	·517	·742	·499	·534	·270	·395	16·870

The total yearly amount of rain which fell during every hour is shown by the numbers at the foot of the Table; the greatest of these is 1·751 inch, between 4h and 5h, and the smallest is 0·270, between the hours of 22 and 23.

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TABLE XII. Showing the Total Monthly amount of Rain which fell during every Hour at the height of 50 feet above the ground.

1866. Month.	Between what Hours.																							Fall of Rain in Month.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	·042	·035	·044	·044	·012	·040	·041	·007	·012	·002	·001	·029	·114	·104	·071	·026	·018	·029	·070	·067	·045	·151	·092	·057	1·153
February	·074	·155	·202	·021	·010	·025	·036	·049	·029	·090	·248	·153	·180	·010	·062	·055	·024	·019	·145	·072	·112	·137	·081	·022	2·011
March	·007	·028	·022	·001	·025	·023	·030	·020	·045	·126	·085	·068	·046	·029	·051	·032	·017	·010	·005	·074	·040	·045	·063	.....	0·892
April	·070	·065	·151	·358	·315	·017	·058	·024	·030	·045	·056	·017	·051	·010	·014	·002	.....	·020	·009	·014	·008	·010	.....	·036	1·380
May	·005	·002	·005	.....	·040	·005	·012	.....	·062	·013	·145	·143	·278	·282	·453	·170	·062	·011	·012	·024	·040	·041	·018	·018	1·841
June	·020	·050	·041	·014	·020	.....	·057	·231	·123	·290	·364	·175	·210	·087	·053	·225	·248	·045	.....	·003	·027	·160	·042	·003	2·488
July	·008	·024	·067	.....	.....	.....	·016	.....	·021	·063	·015	·010	.....	.....	·014	·057	·100	.....	.....	.....	.....	.....	.....	·130	0·525
August	·209	·047	·047	·027	·053	·030	.....	.....	.....	·001	·001	·071	·061	·026	·018	·026	·053	·057	·023	·068	·041	·002	·014	·055	0·930
September	·029	·117	·057	·090	·197	·062	·072	·026	·094	·104	·016	·017	·035	·032	·128	·257	·126	·166	·123	·219	·030	·089	·052	·039	2·177
October	·172	·097	·076	·021	·061	·056	·041	·026	·087	·099	·040	·003	·001	.....	·090	·092	·229	·146	·070	·082	·066	·102	·024	·087	1·768
November	·028	·030	·006	·005	·022	·021	·003	·057	.....	·056	·060	·052	·040	·090	·042	·057	·047	·034	·004	.....	.....	·070	·030	·020	0·774
December	·027	·057	·110	·002	·002	·006	·009	·018	·056	·066	·041	·052	·065	·049	·028	·025	·020	·039	·011	·046	·042	·063	·034	·033	0·901
Sums	·691	·707	·828	·583	·757	·285	·375	·458	·559	·955	1·072	·790	1·081	·719	1·024	1·024	·944	·576	·472	·669	·451	·870	·450	·500	16·840

The total yearly amount of rain which fell during every hour is shown by the numbers at the foot of the Table; the greatest of these is 1·081 inch, from 12h to 13h, and the smallest is 0·285 inch, between the hours of 5 and 6.

By collecting together the sums of all the preceding Tables, the next Table is formed.

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TABLE XIII. Showing the Number of Times Rain fell, and the amounts fallen in every Hour, in each Year, and the average frequency and the average amounts from all the Years.

Between the Hours	Number of Times Rain fell during each Hour in the Year.						Mean Number of Times Rain fell.	Total amount of Rain, in Inches, in each Hour in the Year, 50 feet above the ground.						Mean amount of Rain, 50 feet above the ground.	Mean amount of Rain, on the ground.
	1861.	1862.	1863.	1864.	1865.	1866.		1861.	1862.	1863.	1864.	1865.	1866.		
								in.	in.	in.	in.	in.	in.	in.	in.
0 and 1	28	38	20	28	18	32	27·3	0·723	0·891	0·195	0·336	0·473	0·691	0·552	0·92
1 ,, 2	31	40	22	26	18	37	29·0	0·949	0·831	0·277	0·198	0·863	0·707	0·638	1·06
2 ,, 3	32	47	27	25	18	39	31·3	1·036	1·002	0·618	0·286	0·563	0·828	0·722	1·20
3 ,, 4	34	44	32	21	16	30	29·5	0·869	0·980	0·571	0·182	1·005	0·583	0·698	1·16
4 ,, 5	29	43	28	21	15	27	27·2	0·756	0·791	0·633	0·237	1·751	0·757	0·821	1·37
5 ,, 6	25	40	23	24	23	19	25·7	0·541	0·579	0·452	0·267	0·994	0·285	0·519	0·86
6 ,, 7	20	33	24	21	23	20	23·5	0·278	0·581	0·426	0·265	0·711	0·375	0·439	0·73
7 ,, 8	19	34	24	18	17	22	22·3	0·599	0·814	0·368	0·252	0·536	0·458	0·505	0·84
8 ,, 9	21	32	20	22	21	25	23·5	0·309	0·497	0·504	0·380	0·689	0·559	0·490	0·82
9 ,, 10	15	30	19	20	27	25	22·7	0·319	0·625	0·350	0·382	1·000	0·955	0·605	1·01
10 ,, 11	16	27	16	21	19	30	21·5	0·333	0·513	0·581	0·371	0·428	1·072	0·549	0·92
11 ,, 12	20	26	20	20	19	33	23·0	0·435	0·657	0·435	0·491	0·610	0·790	0·569	0·95
12 ,, 13	21	30	22	22	23	30	24·7	0·402	0·622	0·387	0·595	0·808	1·081	0·649	1·08
13 ,, 14	25	27	20	21	20	28	23·5	0·565	0·318	0·660	0·903	0·566	0·719	0·622	1·04
14 ,, 15	22	24	22	23	22	28	23·5	0·333	0·713	0·502	0·459	0·481	1·024	0·585	0·98
15 ,, 16	20	32	26	22	18	25	23·8	0·342	1·057	0·438	0·669	1·152	1·024	0·780	1·30
16 ,, 17	22	31	20	26	26	27	25·3	0·459	0·704	0·652	0·827	0·552	0·944	0·689	1·15
17 ,, 18	26	33	19	22	21	24	24·2	0·566	0·729	0·949	0·559	0·731	0·576	0·685	1·14
18 ,, 19	25	38	26	18	19	27	25·5	0·568	0·837	0·745	0·414	0·517	0·472	0·592	0·99
19 ,, 20	19	37	29	14	25	31	26·0	0·384	1·065	0·749	0·333	0·742	0·669	0·657	1·09
20 ,, 21	25	34	24	18	22	28	25·2	0·460	0·684	0·679	0·391	0·499	0·451	0·527	0·88
21 ,, 22	28	27	15	17	17	31	22·5	0·608	0·467	0·330	0·551	0·534	0·870	0·560	0·93
22 ,, 23	17	25	21	19	11	24	19·5	0·440	0·324	0·242	0·305	0·270	0·450	0·339	0·57
23 ,, 24	28	37	18	20	13	26	23·7	0·673	0·572	0·360	0·238	0·395	0·500	0·456	0·76

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The first thing which strikes us in this Table is, that the hours of greatest frequency of rain in one year are not those of other years; and neither are the greatest amounts of rain at any hours in one year distinguished by the greatest falls at the same hours in other years.

It is also to be remarked that in those years of small rainfall, or those less than the average, viz. in the years 1861, 1863, and 1864, there are some hours whose average frequency have been exceeded, viz. in 1861, at every hour between 21^h and 5^h, with the exception of 22^h to 23^h, and between the hours 13 to 14 and the hours 17 to 18; in 1863 from 3^h to 5^h, 7^h to 8^h, 15^h to 16^h, 19^h to 20^h, and 22^h to 23^h; in 1864 there were only two such instances, and both to small amounts, viz. 0^h to 1^h, and 16^h to 17^h.

In those years in which the rainfall has been above the average, viz. in 1862, 1865, and 1866, the frequency of rain is very different at the different hours; in the year 1862 the excess of frequency over the average number of falls was no less than 215; in some hours, particularly from 0^h to 9^h, the excess of frequency was from nine to sixteen each hour, whilst from 10^h to 14^h it was only from three to five in excess, and between 14^h to 15^h the average number of rainfalls due to that hour only took place.

The wet year 1865 is remarkable; the number of times of frequency exceeding the average was only two, and implies the average amount per fall must have been greater than in any other.

In the next wet year, 1866, there are instances in which, during a period of four hours, the number of rainfalls were only their averages. The same remarks apply to the amounts in the dry years 1861, 1863, and 1864: there are hours of excess above the average, viz. in 1861 from 21^h to 4^h, from 5^h to 6^h, and 7^h to 8^h; in 1863 there are seven instances, viz. from 8^h to 9^h, 10^h to 11^h, 13^h to 14^h, and from 17^h to 21^h; in 1864 there are two, viz. from 13^h to 14^h and from 16^h to 17^h.

Likewise in the wet years 1862, 1865, and 1866, there are hours of deficiency of rain, viz. in 1862 between 4^h to 5^h, 10^h to 11^h, 12^h to 14^h, and 21^h to 23^h; the fall was less than the average for these hours. In 1865 the falls between 2^h and 3^h, 10^h to 11^h, 13^h to 15^h, 18^h to 19^h, and from 20^h to 1^h were deficient; and in 1866 the hours from 3^h to 8^h, 17^h to 19^h, and 20^h to 21^h were less than the average.

From these deductions it is evident that the fall of rain is very differently distributed over the twenty-four hours in different years.

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Extracting from Tables I. to VI. the total number of rain-falls, we find that, in the year 1861, the number of times rain fell was 568, in 1862 was 809, in 1863 was 537, in 1864 was 509, in 1865 was 471, and in the year 1866 was 668. The amounts of rain collected on the ground in these years were 20·4 ins., 26·3 ins., 19·7 ins., 16·4 ins., 28·7 ins., and 30·7 ins. respectively. Dividing these yearly amounts by the above yearly numbers, we find that the average individual fall of rain on the ground was—

in.	
0·036 in the year	1861
0·033 in the year	1862
0·037 in the year	1863
0·032 in the year	1864
0·061 in the year	1865
0·046 in the year	1866

The year distinguished by the heaviest falls was 1865; and that by the smallest was the preceding year 1864.

And by dividing the numbers in the last column of Table XIII. by the number of times of rain in each hour in column 8 of the same Table, we find that—

	h.		h.		in.
The average fall between	0	and	1	was	0·034
„ „ „	1	„	2	„	0·036
„ „ „	2	„	3	„	0·039
„ „ „	3	„	4	„	0·039
„ „ „	4	„	5	„	0·051
„ „ „	5	„	6	„	0·034
„ „ „	6	„	7	„	0·031
„ „ „	7	„	8	„	0·038
„ „ „	8	„	9	„	0·034
„ „ „	9	„	10	„	0·045
„ „ „	10	„	11	„	0·043
„ „ „	11	„	12	„	0·040
„ „ „	12	„	13	„	0·044
„ „ „	13	„	14	„	0·046
„ „ „	14	„	15	„	0·042
„ „ „	15	„	16	„	0·055
„ „ „	16	„	17	„	0·046
„ „ „	17	„	18	„	0·047
„ „ „	18	„	19	„	0·039
„ „ „	19	„	20	„	0·042
„ „ „	20	„	21	„	0·035
„ „ „	21	„	22	„	0·041
„ „ „	22	„	23	„	0·029
„ „ „	23	„	24	„	0·032

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The falls appear heaviest between 9^h and 18^h (9^h P.M. and 6^h A.M.), the heaviest being 0·055 inch, between 3^h and 4^h A.M.; and at these times the general frequency is small; the falls appear smallest, and frequency is the least, during the hour immediately preceding noon; the frequency of rain is greatest in those hours following noon, and the falls at these times are intermediate in amount.

By dividing the twenty-four hours into two groups of twelve hours each (0^h to 12^h), noon to midnight in the one (12^h to 24^h), midnight to noon in the other—

Between the Periods.	Number of Times Rain fell during the period.						Mean Number of falls.	Total amount of Rain during the Period, 50 feet above the ground.						Mean amount of Rain, 50 feet high.	Mean amount of Rain on the ground.
	1861.	1862.	1863.	1864.	1865.	1866.		1861.	1862.	1863.	1864.	1865.	1866.		
								in.	in.	in.	in.	in.	in.	in.	in.
Noon to Midnight	290	434	275	267	234	339	306·5	7·147	8·761	5·410	3·647	9·623	8·060	7·108	11·85
Midnight to Noon	278	375	262	242	237	329	287·2	5·800	8·092	6·693	6·244	7·247	8·780	7·143	11·90

From these numbers it appears that, in every year except 1865, the frequency of rain was greater between noon and midnight than between midnight and noon.

It also appears that the fall of rain was greater between noon and midnight than between midnight and noon in the years 1861 and 1865, the one a dry and the other a wet year; that in the years 1863 and 1864 less rain fell in the first than in the second period; whilst in 1862 and 1866, both wet years, the amount was nearly alike, and the mean for the six years was sensibly alike in the two periods.

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By dividing the twenty-four hours into two periods of twelve hours each, 6^h to 18^h in one (night), and 18^h to 6^h in the other (day), the next Table is formed.

Between the Periods.	Number of Times Rain fell during the Period.						Mean Number of falls.	Total amount of Rain during the Period, 50 feet above the ground.						Mean amount of Rain, 50 feet high.	Mean amount of Rain on the ground.
	1861.	1862.	1863.	1864.	1865.	1866.		1861.	1862.	1863.	1864.	1865.	1866.		
								in.	in.	in.	in.	in.	in.	in.	in.
6^h P.M. to 6^h A.M.	247	359	252	258	356	317	281·5	4·940	7·830	6·252	6·153	8·264	9·577	7·169	11·95
6^h A.M. to 6^h P.M.	321	450	285	251	215	351	312·2	8·007	9·023	5·851	3·738	8·606	7·263	7·081	11·80

It appears here that the frequency was nearly the same in the two periods in the year 1864, was less in the night period than in the day in the years 1861, 1862, 1863, and 1866, and greater in the night than in the day in the remaining year 1865.

That the amounts during the night period in the years 1861 and 1862 were less than in the day period, that they were greater during the night in the years 1863, 1864, and 1866 than during the day, and were nearly alike in the year 1865 in both periods. The average for the six years is sensibly the same for both periods, and very nearly the same in the other twelve-hourly periods. The amount of rain in any consecutive twelve hours seems to be nearly alike.

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By dividing the day into four periods of six hours starting from 0^h (noon), the following Table is formed.

Between the Periods.	Number of Times Rain fell during the Period.						Mean Number of times.	Total amount of Rain during the Period, 50 feet above the ground.						Mean amount of Rain, 50 feet high.	Mean amount of Rain on the ground.
	1861.	1862.	1863.	1864.	1865.	1866.		1861.	1862.	1863.	1864.	1865.	1866.		
								in.	in.	in.	in.	in.	in.	in.	in.
Noon to 6^h P.M. ...	179	252	152	145	108	184	170·0	4·874	5·074	2·746	1·506	5·649	3·851	3·950	6·58
6 P.M. to Midnight	111	182	123	122	126	155	136·5	2·273	3·687	2·664	2·141	3·974	4·209	3·158	5·26
Midnight to 6 A.M.	136	177	129	136	130	162	145·0	2·667	4·143	3·588	4·012	4·290	5·368	4·011	6·68
6 A.M. to Noon ...	142	198	133	106	107	167	142·2	3·133	3·949	3·105	2·232	2·957	3·412	3·131	5·22

These results show that rain fell most frequently in the first quarter, reckoning from noon in all the years, excepting 1865, in which year it fell most frequently in the third quarter; and that it fell less frequently in the second quarter in the years 1861, 1863, and 1866, the third quarter in 1862, and in the fourth in the years 1864 and 1865.

Upon the average of the six years, the frequency of rain was greater between noon and 6 P.M., and less frequent in the second period, viz. from 6 P.M. to midnight; and the frequency in the third and fourth periods were nearly alike, the third being a little in excess over the fourth.

The greatest amounts of rain fell in the first period (noon to 6^h P.M.) in the years 1861, 1862, and 1865; in the third period in the years 1863, 1864, and 1866; and the least in the first period in the year 1864; in the second in the years 1861, 1862, 1863; in the fourth in the years 1865 and 1866.

Upon the average, the greatest amount of rain fell in the third quarter, reckoning from noon, it being a little in excess over that which fell in the first quarter; and the least in the fourth quarter, but which is only slightly in excess over the amount which fell in the second quarter; the average amount, therefore, in the first and third are nearly alike; and those of the second and fourth are also very nearly alike. The percentage in the first period, noon to 6^h P.M., was 27·7; in the second period, 6^h P.M. to midnight, was 19·8; in the third period, was 28·1; and in the fourth, was 22·0.

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The next Table was formed by dividing the twenty-four hours into eight groups of three hours each, reckoning from noon.

Between the Periods.	Number of Times Rain fell during the Period.						Mean Number of Times.	Total amount of Rain during the Period, 50 feet above the ground.						Mean amount of Rain, 50 feet high.	Mean amount of Rain on the ground.
	1861.	1862.	1863.	1864.	1865.	1866.		1861.	1862.	1863.	1864.	1865.	1866.		
h. h.								in.	in.	in.	in.	in.	in.	in.	in.
0 to 3	91	125	69	79	54	108	87·7	2·708	2·724	1·090	0·820	1·899	2·226	1·911	3·18
3 „ 6	88	127	83	66	54	76	82·3	2·166	2·350	1·656	0·686	3·750	1·625	2·039	3·40
6 „ 9	60	99	68	61	61	67	69·3	1·186	1·892	1·298	0·897	1·936	1·392	1·433	2·39
9 „ 12	51	83	55	61	65	88	67·2	1·087	1·795	1·366	1·244	2·038	2·817	1·724	2·88
12 „ 15	68	81	64	66	65	86	71·7	1·300	1·653	1·549	1·957	1·855	2·824	1·856	3·09
15 „ 18	88	96	65	70	65	76	76·7	1·367	2·490	2·039	2·055	2·435	2·544	2·155	3·59
18 „ 21	69	109	79	50	66	86	76·5	1·412	2·586	2·173	1·138	1·758	1·592	1·776	2·96
21 „ 24	73	89	54	56	41	81	65·7	1·721	1·363	0·932	1·094	1·199	1·820	1·355	2·26

From these results it appears that rain fell most frequently in the first period (0^h to 3^h) in the years 1861, 1864, and 1866, in the second period (3^h to 6^h) in the years 1862 and 1863, and in the seventh period (6^h A.M. to 9^h A.M.) in the year 1865.

That its frequency was the least in 1866 in the third period (6^h to 9^h), in the years 1861 to 1863 in the fourth period (9^h to 12^h), in 1862 in the fifth period, in the year 1864 in the seventh, and in the year 1865 in the eighth, or in the three hours preceding noon.

Upon the average of the years, least frequently in the three hours preceding noon, and most frequently in the three hours following noon.

The fall of rain was greatest in the first period (0^h to 3^h) in the years 1861 and 1862; in the second period in the year 1865; in the fifth period (midnight to 3^h A.M.);

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in the year 1866 being but slightly in excess over that of the preceding period; in the sixth period in the year 1864; and in the seventh period (6h A.M. to 9h A.M.) in the year 1863.

The fall of rain was least in the second period (3h P.M. to 6h P.M.) in the year 1864; in the third period in 1866; in the fourth period in the year 1861; and in the three hours preceding noon in the years 1862, 1863, and 1865.

Upon the average of years, the greatest falls were between the hours of 3h A.M. and 6h A.M., the next in order being between 3h P.M. and 6h P.M., and the least fall in the three hours preceding noon.

The order of percentage of falls is as follows:—9h A.M. to noon was 9·5, 6h to 9h P.M. was 10·1, 9h P.M. to midnight was 12·1, 6h to 9h A.M. was 12·5, 0h to 3h A.M. was 13·4, 0h to 3h P.M. was 13·4, 3h to 6h P.M. was 14·3, and 3h to 6h A.M. was 15·2.

By laying the number of times rain fell in every hour in each year from Table XIII., we see that in frequency of rain, the years 1861, 1862, and 1863 are something similar; that the curves of the other years are different from these, and also differ among themselves. That of the year 1865 is very different from all the rest, both in respect to frequency and distribution (Plate I.).

By laying the amounts of rainfall on the ground in diagram, they differ from each other, and that in the year 1865 very much from the rest; this was owing mainly to a heavy fall of rain in May (see Table XI.), between the hours of 4 and 5, and of heavy falls in May and July (see Table XI.), causing the very high peaks in the diagram at these times, which influence the form of the curve, and, when laid down from eight points only, or from the numbers in the last Table, as was done by Mr. Baxendell, give an approximate curve to that of magnetic declination; a very different curve would have been formed had the numbers in the year 1864 been used.

By laying the numbers down both for frequency and amounts from all the years, and comparing them together, it appears that in the early afternoon hours the greatest frequency of rain is in general in agreement with the greatest falls; but at the time of the second maximum fall, in the early morning hours, there is not a corresponding greatly increased frequency, implying that the amount of rain per fall is larger at these hours than at the time of first maximum, in the earlier afternoon hours.

By laying down the curve of magnetic declination, and com-

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paring it with the two preceding curves, there is a kind of agreement between the curves of frequency and that of the magnetic variation; but in comparing it with that of the amount of rain, there is nothing similar in the two curves, and therefore there does not seem to be any connexion between the diurnal movements of the declination magnet and the diurnal fall of rain. The curve of diurnal rainfall, from all the years, seems in some way connected with the position of the sun; the least frequency of rain, and the smallest falls, take place during the morning hours, whilst the sun is ascending; the greatest frequency, and most rain, take place in the afternoon hours, whilst the sun is descending. A second minimum of frequency and of amount of rain takes place at, or near, the mean time of sun-setting; an increase of frequency then takes place, but not a large one, whilst a considerable increase in amount takes place till a little before the time of sun-rising, when the temperature is usually at its minimum, when a second maximum takes place, somewhat less in amount than that of about twelve hours before; then both frequency and amount decrease to their least frequency and smallest falls, between the hours of 10 and 11 A.M.

II. *On an Improved Method of Dividing Alcohol and other Thermometers.* By WILLIAM ACKLAND, Esq., of Messrs. Horne and Thornthwaite, Opticians, Newgate Street.

IN the manufacture of thermometers for low temperatures, considerable difficulties are experienced owing to equal increments of temperature not causing an equal increase of volume of the fluid employed; and this unequal expansion gives rise to considerable errors even within limited ranges of temperature.

If, in constructing an alcohol thermometer, we select a tube with uniform bore, we find, on giving it certain fixed points, corresponding to an equal number of degrees between each point, that the spaces so obtained are each diminishing in length as we descend; hence the ordinary mode of equal divisions between the ascertained points is found to give inaccurate results. An important question therefore arises,—Can we so subdivide our tube that each subdivision shall be in its proper place?

During the autumn of last year, Mr. Glaisher mentioned this

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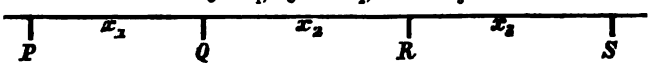
subject to me, and at the same time offered some valuable suggestions to remove this difficulty, and caused me to direct my attention to this subject. Many subsequent interviews with that gentleman, extending over some months, enabled me to mature my first idea, and aided by his valuable assistance and counsel, the success aimed at has been attained; and I am now in a position to state that I have completed a dividing-engine on an entirely new principle, which may strictly be termed "Interpolating;" for, whilst between any consecutive terms taken at regular and fixed intervals we can by numerical interpolation find intermediate terms conformable to the law of the series; so, between fixed and determined points of our thermometer, we can, by using the "interpolating-engine," so divide the intervening spaces that they shall conform to the varying nature of the series, or, in other words, that the divisions shall increase in magnitude as we ascend the scale in such proportions as are demanded by the expansion of the alcohol and the bore of the tube employed.

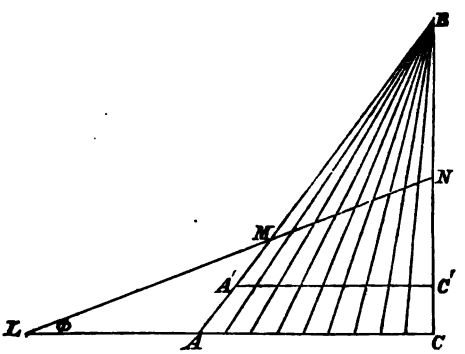
To illustrate this new method I have invented, let us suppose we have ascertained the fixed points, P, Q, R, S, of a thermometer corresponding to equal differences of temperature. And let

$$PQ = x_1,\ QR = x_2,\ RS = x_3$$



It is desired to divide the intervening spaces each into ten divisions, so that each division shall occupy its true position.

To do this, take any right-angled triangle, A B C, and divide the side A C into ten equal parts by straight lines drawn from B.



Then, if a straight line, as A′ C′, be drawn parallel to A C, it

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will be divided into ten equal parts; but if it be drawn not parallel to A C, it will be divided into ten unequal parts.

To apply this to the thermometer to be divided, draw a transversal L M N cutting A C produced in L, at an angle ϕ, so that

$$\tan\phi=\frac{x_2-x_1}{x_2+x_1}\tan A,$$

and

$$M N=x_1.$$

On doing this, it becomes evident that such a line, so placed, will be divided into ten unequal parts, proportionate to the law governing the series, and we can in the same manner, by using the same formula, divide any number of spaces with equal accuracy.

It remains, therefore, mechanically to transfer such divisions to our thermometer, previously marked off at equal intervals of temperature, in order to secure its correctness to even second differences.

This mechanical copying can be done by the dividing-engine before referred to; and it is worthy of note, that the formula and engine equally apply to the more correct dividing of mercurial thermometers having unequal or varying diameters of bore, as also to the construction of hydrometers of absolute accuracy.

I can easily understand that whilst the mathematician may appreciate the formula thus introduced, and also its successful application, those accustomed to the construction of thermometers would hesitate to adopt it, from the fact that the plan involves a series of calculations for each thermometer, which would involve considerable loss of time and risks of inaccuracies, if these computations were hastily done; hence my first idea was to compute a series of tables; but this was attended with only partial success. My attention was then directed to the mechanical solution of these problems, the result of which was the invention of a little piece of apparatus, which may be called a computer, consisting of a sliding-rule, index-arm, and scale. Suppose we wish to divide accurately the space x_1, formerly given; we set the distance from P to Q on the slide, to that of Q to R on the fixed scale, and the index-arm at once points to the angle on the scale which M N must make with A C on our divided triangle.

In use, this computer is found both trustworthy and simple, and facilitates what would otherwise have been tedious to perform and liable to inaccuracies when done.

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Having devised a method of dividing a thermometer-tube accurately, I next turned my attention to the most suitable strength of alcohol to be employed in filling these thermometers; and as but little can be gained by referring to our scientific writers on this subject, I undertook a series of experiments to satisfy myself on this point.

Now it is well known that the expansion of alcohol by heat is not proportionate to its change of temperature; and we are consequently unable to express its corresponding coefficient by a simple formula, as for metals and mercury, but must adopt the more complex expression of M. Biot,

$$d=at+bt^2,$$

where a and b are the required coefficients, and t the temperature. The coefficients of absolute alcohol are constant for all temperatures, but inasmuch as this fluid becomes weaker from momentary exposure to the air, and the mere pouring from one bottle to another not only alters its specific gravity but also its rate of expansion and its coefficient, it becomes an important point to select some other strength less liable to those changes, which only tend to inaccuracies, however much we may strive to prevent them. In making this selection, various specific gravities and of varying purities were tested, and the results led to the selection of alcohol having a specific gravity of ·815, as spirit of this strength, if pure, and *free from methylated spirit*, fusil-oil &c., has its coefficients as constant as those of absolute alcohol, and it is but little liable to undergo those changes that seem to thwart our efforts when using a stronger sample.

I had entertained the hope that at this Meeting I should have been enabled to have exhibited a series of alcohol thermometers made on the principle above indicated; but a few only have as yet been completed.

Those accustomed to scientific investigations will readily appreciate the difficulties met with at every stage, and I must plead the little time at my disposal for the present deficiency, and merely state in conclusion that, before the approaching Christmas, thermometers made on the plan above indicated, will be ready for those who may wish to test their accuracy.

Before closing these remarks, I cannot allow this opportunity to pass without rendering my hearty thanks to your worthy Chairman for the many practical suggestions he has so freely given me,

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all tending to lessen the difficulties encountered, and without which my first crude idea would have been still in embryo.

III. *On the Erection of Mr. Cator's Anemometer at Beckenham.*

By C. O. F. CATOR, Esq., M.A., Secretary.

MY anemometer, a description of which was read before the Society in January 1866 (vol. iii. p. 49), was tested at the Royal Observatory, Greenwich, from March to September in that year; and a short notice of the comparison of pressures will be found in the Annual Report of the Society, read at the June Meeting 1866 (vol. iii. p. 214). This instrument was erected in the early part of last September at Beckenham, on a site about 160 feet above the level of the sea, halfway up a steepish hill facing the S., therefore very much exposed on the S. and W., but very much protected on the N. and E. by thick and high trees on the summit of the hill. It is therefore in a very eligible position for all winds from the S.E., S.W., and N.W.; but it seems probable from the configuration of the ground, that winds from N., N.E., and E. would pass over the instrument without duly recording themselves.

As its position is about five miles south of the Royal Observatory, it will be interesting at times to compare the results of the two anemometers, and particularly so in sudden changes of the wind, noting the difference of time and strength, and tracing the course, so far, of any storm, gale, or squall.

The interval of time since it has been in operation being short, it is premature to enter into detail; but it may be worth while to mention one or two of the principal features already noticed, viz.—

From 7 A.M. of the 16th of September to 10 P.M. of the 18th of September (sixty-three hours), the air was in constant motion with a northerly wind; the maximum pressure during this time was 4·5 lbs.

From 5 A.M. 23rd of September to 5 P.M. 24th (thirty-six hours), it was again in constant motion, but in this case the direction was from S.W. gradually to N. The maximum pressure was 5·5 lbs. at 4.30 P.M.

Another period of constant motion was from 1.30 A.M. of the

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28th of September to 9 A.M. of the 1st of October (about eighty hours), the wind being S.W. all the time, till the last fourteen hours, when it gradually veered to the N. and became calm. 8 lbs. was the maximum pressure at 11.30 A.M. of the 30th of September.

Again, from 11 P.M. of the 6th of October to 6 P.M. of the 8th of October, with a wind from S.W. to N.W., which ended with N.W.

From midnight of the 10th–11th of October to midnight of the 13th–14th of October was a calm period; but the change in direction was peculiar, viz. at midnight of the 10th–11th of October there was a sudden and complete change from N. through W. to S. (*i. e.* a retrograde motion); then it veered gradually round through E. to N. by midnight of the 12th–13th of October, in a period of forty-eight hours. Then the same thing happened again; at midnight of the 12th–13th of October there was a sudden shift from N. through W. to S., and then it veered gradually round through E. to N.E. by midnight of 13th–14th of October. It seems rather remarkable that the sudden shifts should be in each case at midnight.

From 3 A.M. to 2 P.M. of the 27th of October there was a strong wind, 9 lbs. maximum at 0.30 P.M.; at 1.30 P.M. there was a strong squall, and sudden shift from S.W. to N.W.; and almost immediately afterwards the wind entirely ceased.

From 10.30 P.M. of the 28th of October to 8.30 A.M. of the 30th of October (thirty-four hours), there was a strong wind all the time, maximum 7·7 lbs. at 2 P.M. 29th, direction being from S.W. till the last eight hours, when it moderated and changed gradually to N.W.

From 4.30 P.M. of the 30th of October to 1 P.M. of the 2nd of November (nearly seventy hours) the air was in constant motion, but never very strong, except for the six hours from 8.30 A.M. to 2.30 P.M. November 1, the maximum being 6 lbs. at 11.45 A.M. The direction was S.W. till 3 P.M. of November 1, then N.W. and S.W.

At 10 P.M. of the 4th of November the wind changed from W. to N.; and there set in a long calm period, which lasted till 12.30 in the night of 13th–14th of November, when a gentle breeze from E. arose, this period, during which no pressure was recorded, curiously enough just ending at the time the meteors were expected to be first seen, the direction having been northwards nearly the whole time during the calm.

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From midnight of the 15th–16th of November (the wind having just then reached N. from S.E. though E.) till 3.30 A.M. of the 18th, there was strong wind the whole time from N.N.E., the maximum being 8 lbs. at 6.30 A.M. on the 17th of October.

In the whole period from the 8th of September to the 17th of November there were thirteen days in which no pressure was recorded, but these included the calm period above mentioned, viz. the eight consecutive days 5th–12th of November; the direction on these calm days having been generally S., N.E., or N.

The four instances of greatest pressure were—

	lbs.	h m		
September 30 ...	8	at 11 30 A.M.	with a	S.W. wind.
October 27	9	„ 0 30 P.M.	„	S.S.W. „
October 29	7·7	„ 2 0 P.M.	„	S.W. „
November 17 ...	8	„ 6 30 A.M.	„	N.N.E. „

It seems, on looking over the sheets, to have been nearly always calm, or nearly so, when the wind is changing in a retrograde direction.

It seems also worthy of notice that the sudden shifts of the wind in calm weather have been at or near midnight.

IV. *Meteorological Results deduced from daily observations taken at Leamington during the years* 1862, 1863, 1864, 1865, *and* 1866; *latitude* 52° 17′ *N., longitude* 1° 32′ *W., height above sea-level* 195 *feet.* By S. URWICK JONES, Esq., F.M.S.

Description of Instruments employed.

THE barometer is a standard upon Fortin's principle, diameter of the tube 0·4 inch, and has been verified at Kew Observatory.

The dry- and wet-bulb thermometers and the maximum thermometer have also been verified at Kew.

The minimum thermometer has been tested by Mr. Glaisher.

The readings of the barometer have been corrected for index-error, capillary action, temperature, and diurnal range, and reduced to the sea-level.

The thermometers are placed in a stand, no stand being less than 4 feet from the ground; and the corrections for index-error

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and diurnal range have been applied to the several readings; the calculations to obtain the mean temperature, dew-point, and humidity have been made in accordance with Mr. Glaisher's Tables; the rain-gauge is emptied every day at 9 A.M.

Average of five years.

Reading of the barometer at 32° and sea-level ...	29·904 in.
Temperature of the air	49°·0
Daily range of temperature	14°·4
Degree of humidity	79
Temperature of dew-point.....	42°·2
Rainfall	24·360 in.

Month.	Mean Height of Barometer at 32° and sea-level.	Mean Pressure of Dry air at 32° and sea-level.	Highest Reading of the Thermometer in the shade.	Lowest Reading of the Thermometer.	Range of Temperature in the Month.	Mean of all Highest.	Mean of all Lowest.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew-point.	Mean Elastic Force of Vapour.	Mean Degree of Humidity, saturation = 100.	Number of Days on which Rain fell.	Amount collected.
1862.														
January ...	29·980	29·763	55·0	22·0	33·0	43·0	34·5	8·5	38·5	36·6	·217	91	10	2·540
February	29·750	29·539	56·0	22·0	34·0	45·6	36·5	9·1	39·8	35·9	·211	86	6	0·630
March.....	29·600	29·356	60·0	21·0	39·0	48·2	37·5	10·7	42·2	39·7	·244	91	18	3·254
April	29·980	29·737	72·0	26·0	46·0	57·7	41·0	16·7	48·6	39·6	·243	67	17	1·617
May	29·850	29·564	77·0	38·0	39·0	66·1	47·0	19·1	54·6	43·8	·286	69	17	3·821
June	29·810	29·524	77·0	41·0	36·0	66·2	48·0	18·2	55·7	43·8	·286	69	16	3·308
July	29·850	29·535	78·0	43·0	35·0	69·7	50·0	19·7	58·2	46·3	·315	64	18	2·142
August ...	29·900	29·569	76·0	43·0	33·0	70·2	51·3	18·9	59·0	47·7	·331	68	11	2·056
September	30·000	29·635	73·0	40·0	33·0	65·5	49·4	16·1	56·0	50·3	·365	84	16	3·061
October ...	29·860	29·554	72·0	27·0	45·0	57·9	44·9	13·0	50·5	45·6	·306	84	21	2·580
November	29·980	29·773	55·0	22·0	33·0	43·5	32·6	10·9	37·5	35·4	·207	92	15	0·697
December	30·000	29·754	55·0	30·0	25·0	46·4	38·3	8·1	43·3	39·9	·246	88	15	1·380
Means.....	29·880	29·613	.....	.....	.....	.....	.....	14·0	48·6	42·0	·267	79	.....	.....
Sums.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	180	27·086

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Month.	Mean Height of Barometer at 32° and sea-level.	Mean Pressure of Dry air at 32° and sea-level.	Highest Reading of the Thermometer in the shade.	Lowest Reading of the Thermometer.	Range of Temperature in the Month.	Mean of all Highest.	Mean of all Lowest.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew-point.	Mean Elastic Force of Vapour.	Mean Degree of Humidity, saturation = 100.	Number of Days on which Rain fell.	Amount collected.
1863.														
January ...	29·744	29·517	54·0	27·0	27·0	44·7	36·2	8·5	40·5	37·8	·227	88	18	2·596
February	30·288	30·064	54·0	24·0	30·0	49·3	36·4	12·9	41·8	37·4	·224	84	12	0·449
March.....	29·881	29·660	64·0	25·0	39·0	53·3	35·7	17·6	43·1	37·1	·221	80	8	0·668
April	29·979	29·745	68·0	30·0	38·0	59·1	39·5	19·6	48·7	38·6	·234	71	11	1·463
May	30·028	29·762	78·0	28·0	50·0	63·9	42·1	21·8	52·0	41·9	·266	73	8	0·508
June	29·869	29·550	77·7	43·0	34·7	68·3	48·5	19·8	56·8	46·7	·319	81	16	4·883
July	30·129	29·780	86·3	38·5	47·8	73·5	49·1	24·4	60·2	49·1	·349	69	6	0·573
August ...	29·878	29·509	77·7	45·5	32·2	70·5	54·2	16·3	60·5	50·6	·369	72	16	2·437
September	29·828	29·524	67·0	38·2	28·8	61·7	46·1	15·6	53·2	45·4	·304	76	17	2·256
October ...	29·765	29·462	64·8	33·2	31·6	57·5	44·8	12·7	50·3	45·3	·303	84	20	2·897
November	30·003	29·738	59·8	31·0	28·8	50·3	41·0	9·3	45·2	41·8	·265	88	14	2·281
December	30·076	29·824	54·7	28·0	26·7	46·7	38·7	8·0	42·9	40·5	·252	90	11	0·807
Means.....	29·955	29·682	.....	.....	.....	.....	.....	15·5	49·6	42·6	·273	79	.....	.....
Sums	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	157	21·818

1864.														
January ...	30·014	29·817	52·0	12·5	39·5	39·6	31·9	7·7	35·7	34·2	·197	92	13	1·005
February	29·972	29·778	54·8	17·5	37·3	41·3	32·0	9·3	35·9	33·8	·194	90	10	1·758
March.....	29·670	29·459	61·3	26·8	34·5	48·4	34·7	13·7	40·1	35·9	·211	84	16	2·896
April	30·085	29·854	73·6	34·0	39·6	59·8	41·2	18·6	48·7	38·3	·231	70	7	1·371
May	30·015	29·721	87·6	36·5	51·1	66·9	47·8	19·1	55·3	44·5	·294	71	10	1·840
June	29·931	29·615	75·2	37·5	37·7	68·2	49·7	18·5	57·1	46·4	·316	71	12	0·967
July	30·022	29·647	86·1	44·2	41·9	74·1	51·6	22·5	60·3	51·1	·375	71	7	0·429
August ...	30·091	29·779	86·0	37·0	49·0	72·1	49·4	22·7	58·9	46·1	·312	60	7	0·517
September	29·912	29·587	74·0	42·3	31·7	66·7	49·3	17·4	56·5	47·2	·325	73	13	1·978
October ...	29·856	29·575	66·7	38·0	28·7	57·4	44·9	12·5	50·3	43·4	·281	78	10	2·260
November	29·744	29·514	55·0	27·0	28·0	47·3	35·9	11·4	40·9	38·1	·230	89	13	1·933
December	30·025	29·815	53·7	17·4	36·3	37·9	34·4	6·8	38·0	35·8	·210	91	9	1·914
Means.....	29·944	29·685	.....	.....	.....	.....	.....	15·0	48·1	41·2	·259	79	.....	.....
Sums	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	127	18·868

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Month.	Mean Height of Barometer at 32° and sea-level.	Mean Pressure of Dry air at 32° and sea-level.	Highest Reading of the Thermometer in the shade.	Lowest Reading of the Thermometer.	Range of Temperature in the Month.	Mean of all Highest.	Mean of all Lowest.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew-point.	Mean Elastic Force of Vapour.	Mean Degree of Humidity, saturation = 100.	Number of Days on which Rain fell.	Amount collected.
1865.														
January ...	29·558	29·380	50·8	7·8	43·0	39·5	30·3	9·2	34·4	31·6	·178	88	13	2·734
February	29·876	29·686	52·2	17·0	35·2	40·9	30·4	10·5	35·4	33·3	·190	91	18	2·573
March.....	29·906	29·724	55·2	24·5	30·7	44·7	31·5	11·2	36·8	32·2	·182	83	13	1·001
April	30·043	29·785	76·0	29·0	47·0	65·7	42·4	23·3	51·7	41·1	·258	70	5	0·730
May	29·913	29·632	80·3	33·8	46·5	66·4	46·1	20·3	54·5	43·4	·281	69	15	1·169
June	30·210	29 876	88·8	44·0	44·8	74·5	52·6	21·9	61·1	47·9	·334	66	5	2·087
July	29·941	29·557	85·0	46·7	38·3	74·6	54·6	20·0	62·7	51·7	·384	68	14	3·577
August ...	29·861	29·497	78·0	43·0	35·0	70·0	55·2	14·8	59·2	50·2	·364	76	16	4·107
September	30·244	29·843	86·0	40·2	45·8	74·6	52·7	21·9	61·7	52·9	·401	75	3	0·187
October ...	29·603	29·322	71·7	32·4	39·3	58·4	44·0	14·4	49·9	43·4	·281	79	21	4·857
November	29·864	29·604	56·8	28·5	28·3	49·1	37·9	11·2	43·4	41·3	·260	92	17	2·481
December	30·201	29·954	54·0	28·8	25·2	46·3	37·5	8·8	42·2	40·0	·247	92	9	0·981
Means.....	29·935	29·664	.....	.....	.....	.....	.....	15·6	49·8	42·4	·271	79	.....	.....
Sums	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	149	26·484
1866.														
January ...	29·809	29·562	53·5	25·5	28·0	46·5	37·0	9·5	41·9	40·0	·247	92	21	1·726
February	29·684	29·467	55·3	23·0	32·3	46·3	34·6	11·7	39·6	36·6	·217	89	19	1·365
March.....	29·704	29·490	62·5	19·0	43·5	48·0	34·0	14·0	39·9	36·3	·214	87	16	1·352
April	29·914	29·666	77·0	29·5	47·5	57·7	40·8	16·9	48·0	40·1	·248	71	15	1·573
May	29·983	29·749	73·3	28·7	44·6	62·1	40·4	21·7	50·3	38·6	·234	68	9	1·513
June	29·920	29·558	88·5	43·0	45·5	68·7	52·4	16·3	58·9	50·1	·362	77	14	1·946
July	29·933	29·559	88·0	47·0	41·0	72·9	53·7	19·2	60·0	51·0	·374	79	12	3·355
August ...	29·784	29·444	74·5	44·0	30·5	67·3	52·1	15·2	57·9	48·4	·340	74	17	3·678
September	29·690	29·352	68·0	40·5	27·5	62·2	49·9	12·3	54·8	48·2	·338	80	26	5·831
October ...	29·741	29·430	65·8	33·6	32·2	57·6	46·5	11·1	51·0	46·0	·311	84	11	1·870
November	29·599	29·349	61·5	27·2	34·3	50·2	38·5	11·7	44·0	40·3	·250	86	12	1·798
December	29·925	29·682	58·4	28·2	30·2	47·9	37·4	10·5	42·7	39·6	·243	88	16	1·540
Means.....	29·807	29·531	.....	.....	.....	.....	.....	14·1	49·0	42·9	·276	81	.....	.....
Sums	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	188	27.548

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Diagram shewing the average number of times Rain fell in every hour of the day for each of the years 1861 to 1866 as found from the observations taken at the Royal Observatory, Greenwich.

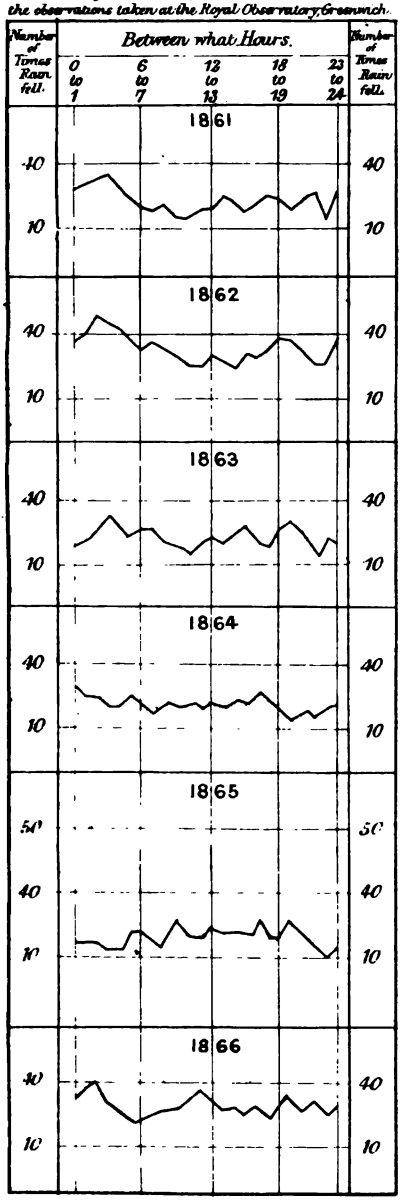

Diagram shewing the average fall of rain on the ground, for every hour of the day in each of the years 1861 to 1866 as found from the observations taken at the Royal Observatory, Greenwich.

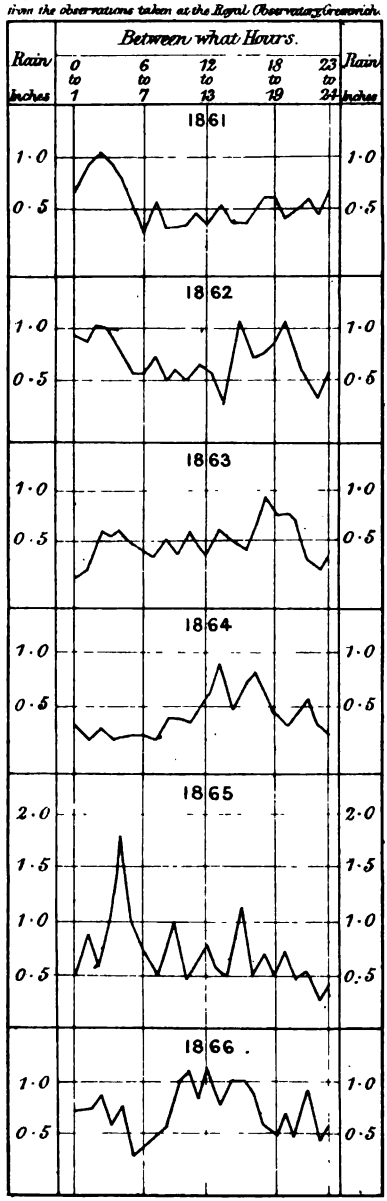

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Diagram shewing the Mean Number of times rain fell in each hour of the day, for the years 1861 to 1866.

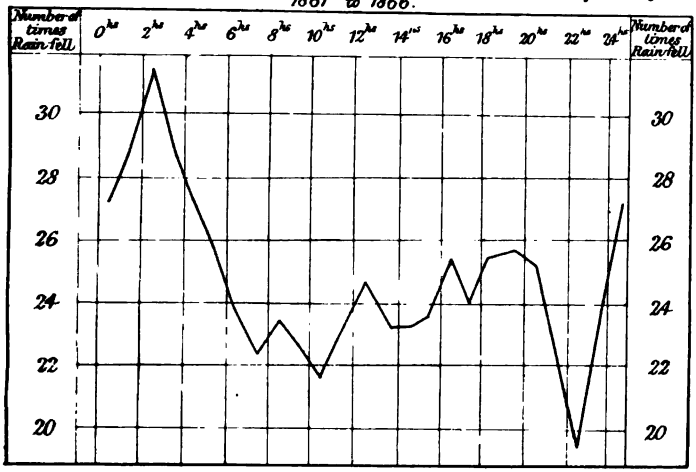
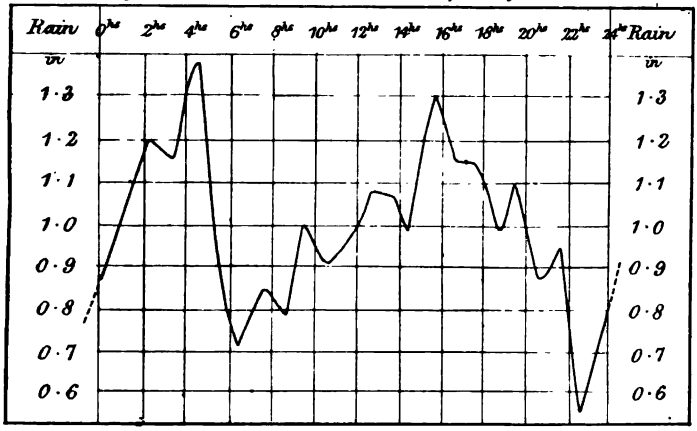
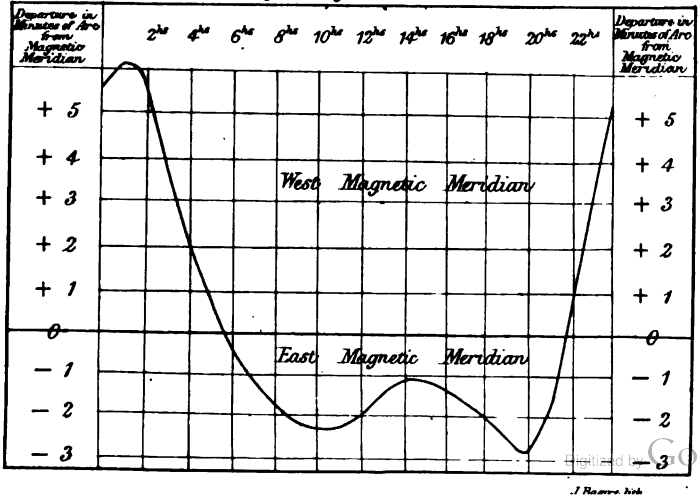


Diagram shewing the Mean Fall of rain in each hour of the day for the years 1861 to 1866.



Diurnal Change of Magnetic Declination at Greenwich.



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EET ABOVE SEA LEVEL,)
. THE GENERAL DIRECTION
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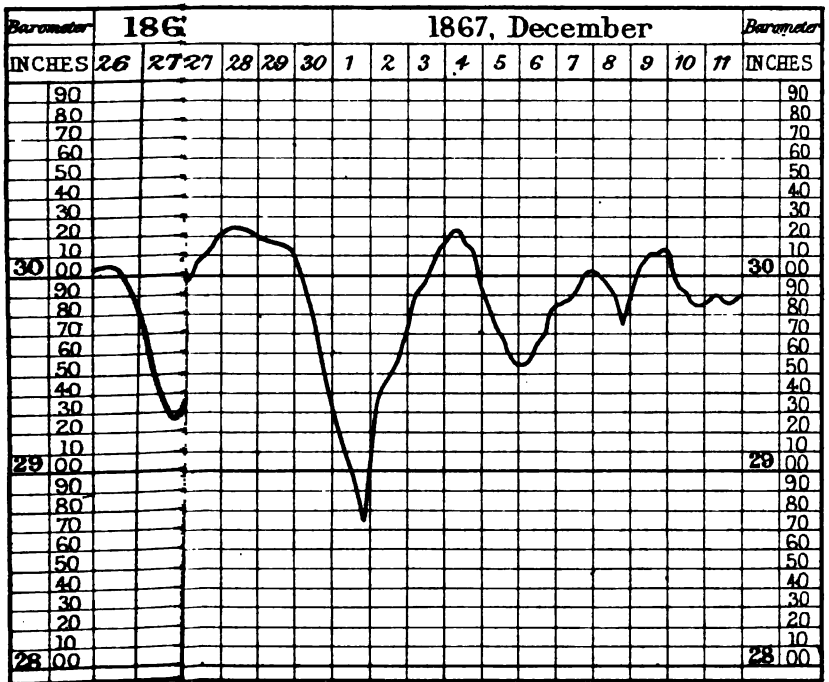

Horizontal Movement of the Air in Miles	General Direction of the Wind.
274	S. : S.S.W.
390	S.S.W. : S.W. : W.S.W.
204	N.N.W. : S.W.
203	S.W. : W.S.W.
208	S.W. : S.
381	S.S.E. : S. S.S.W.
569	S.S.W. : W.N.W.
681	N.N.W.
413	N. by E. : N. by W.
146	N.N.W. Calm : S.W.
262	S.S.W. : W. : N.W.
390	N.W. : N.
477	N.
201	N.N.W. : S.W. : S.E.
49	N.E. : N.N.E. S.W.
264	W.S.W.
288	W. : W.N.W.

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OF

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SESSION 1867–68,

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1868, JANUARY 15.

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EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

Vol. IV. 1868, JANUARY 15. [No. 34.

JAMES GLAISHER, Esq., F.R.S., &c., President, in the Chair.

The names of two Candidates for admission into the Society were read.

V. *On the Frequency of Rain at the different Hours of the Day, in the several Months and Seasons of the Year.* By James Glaisher, Esq., F.R.S., &c.

(Plate III.)

At the last Meeting of this Society I read a paper on the yearly-hourly frequency, and yearly-hourly falls of rain, as based upon the self-registered records at the Royal Observatory, Greenwich, in the six years ending 1866.

In the paper I have now the pleasure of presenting, the results are based on the same series of observations, treated month by month, and season by season.

For this purpose, the first step in the inquiry was, collecting the hourly results in the six Januaries together, then the same for the six Februaries, and so on for every month; and in this way the following Tables were formed:—

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TABLE I. Number of Times Rain fell during every

JANUARY.

Years.	Between											
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.
1861	1	1	1	2	1	1	1	1	1	1	1	1
1862	2	3	2	1	1	3	2	3	2	2	...	...
1863	2	1	2	1	1	2	3	4	3	3	4	5
1864	1	1	1	1	1	1	1	1	2	1	1	1
1865	3	1	2	2	1	2	4	2	4	4	3	4
1866	5	4	2	3	2	1	1	1	1	1	1	4

No rain occurred in four hours in 1861, and in three hours in 1862; but fell most frequently was from 18h to 19h in January 1866, being seven in num- and 1866, and there are nine instances of falling five times.

FEBRUARY.

1861	4	4	5	4	3	2	...	1	1	2	2	5
1862	2	1	2	1	1	1	1	1	...	...	...	...
1863	1	1	1	2	1	...	...	...	1	...	...	...
1864	2	1	1	1	...	1	1	1	1	...	...	...
1865	4	2	4	1	1	3	3	...	1	1	...	1
1866	4	7	5	3	1	2	2	2	3	4	7	5

No rainfall occurred in one instance only in 1861; there were eight instances every hour. The hours in which rain fell most frequently were from 1h to 2h, fell six times during the hour; and there are five instances of falling five times.

MARCH.

1861	1	3	3	3	3	4	4	3	3	3	1	2
1862	5	4	7	6	5	6	2	1	5	5	4	5
1863	...	2	2	3	4	2	4	2	2	2	2	2
1864	6	5	4	3	4	3	3	2	2	3	4	3
1865	...	...	1	1	1	1	...	...	...	1	1	1
1866	1	2	2	1	1	3	1	2	2	3	3	2

No rainfall occurred in nineteen instances, of which there was only one in- which rain fell most frequently were from 17h to 18h in 1861, 2h to 3h and 17h during the hour, and there are twelve instances of falling five times.

APRIL.

1861	2	2	1	1	1	2	1	1	1	...	...	...
1862	3	2	3	2	1	1	1	2	2	2	2	2
1863	1	1	3	4	2	1	1	1	...	...	...	...
1864	2	1	1	1	1	1	1	1	1	1	1	1
1865	...	2	2	...	...	...	...	...	...	...	...	...
1866	3	4	7	8	7	2	3	4	2	2	3	4

In the month of April there were thirty-eight instances of no rain, four of 1866. The hour in which rain fell most frequently was from 3h to 4h in two of five times during this month.

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Hour in every Month in the Years 1861–66.

JANUARY.

what Hours.												
12^h to 13^h.	13^h to 14^h.	14^h to 15^h.	15^h to 16^h.	16^h to 17^h.	17^h to 18^h.	18^h to 19^h.	19^h to 20^h.	20^h to 21^h.	21^h to 22^h.	22^h to 23^h.	23^h to 24^h.	Years.
1	1	3	1	...	1	...	1	1	...	...	1	1861.
1	...	1	2	3	2	4	5	4	3	4	5	1862.
4	2	2	5	3	3	6	5	2	2	3	2	1863.
1	1	1	2	3	3	2	3	3	2	2	2	1864.
6	4	2	1	4	3	3	4	4	4	1	2	1865.
3	5	4	1	1	3	7	4	4	5	6	5	1866.

there is no instance of no rainfall in the other years. The hour in which rain ber; on three occasions rain fell six times during the hour, viz. in 1863, 1865,

FEBRUARY.

1	2	2	2	3	3	4	3	4	4	4	3	1861.
...	...	...	...	1	1	1	1	1	1	1	2	1862.
...	1	2	1	1	3	1	2	2	1	2	...	1863.
1	1	...	...	...	1	1	1	2	3	1	1	1864.
2	3	3	2	3	2	2	1	1	1	2	3	1865.
4	1	2	3	2	3	5	4	6	7	4	2	1866.

in 1862, eight in 1863, seven in 1864, and two in 1865. In 1866 rain fell at 10^h to 11^h, and 21^h to 22^h in 1866, being seven in number; on one occasion rain

MARCH.

2	4	5	3	5	7	6	4	6	5	...	2	1861.
6	4	3	5	5	7	6	4	4	3	3	4	1862.
1	...	...	...	1	...	...	...	1	...	...	...	1863.
3	3	4	2	3	2	4	3	2	2	5	4	1864.
1	1	2	1	2	1	1	2	1	1	...	...	1865.
4	2	1	2	1	1	1	2	1	1	2	...	1866.

stance in 1861, ten in 1863, seven in 1865, and one in 1866. The hours in to 18^h in 1862, being seven in number. On seven occasions rain fell six times

APRIL.

1	2	2	...	2	2	3	2	2	1	1	1	1861.
3	4	4	4	3	3	5	5	6	4	1	3	1862.
1	2	2	1	...	...	...	...	...	...	...	1	1863.
1	2	2	2	2	2	1	1	1	...	1	1	1864.
...	...	2	1	...	...	...	...	...	...	...	...	1865.
2	1	1	1	...	1	2	3	2	1	...	3	1866.

which were in 1861, eleven in 1863, one in 1864, twenty in 1865, and two in 1866. There are two instances of falling seven times, one of six times, and

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TABLE I. Number of Times Rain fell during every

MAY.

Years.	Between											
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.
1861	2	1	1	2	1	...	1	2	3	...	...	2
1862	5	5	3	3	3	3	3	4	4	3	2	2
1863	2	...	...	...	2	3	2	1	...	1	1	2
1864	1	2	2	1	1	3	2	2	2	3	5	5
1865	4	5	1	3	2	2	2	1	1	1	1	...
1866	1	1	1	...	2	1	2	...	2	1	1	2

In the month of May there are ten instances of no rainfall, three of which rain fell most frequently are eight in number, the number of times being three times.

JUNE.

1861	2	5	4	5	3	3	3	3	2	1	1	...
1862	4	2	3	6	5	5	6	4	3	4	4	3
1863	2	3	5	6	4	3	4	5	5	5	2	2
1864	4	4	5	5	5	5	3	2	4	4	3	2
1865	...	1	1	1	1	1	2	4	3	4	2	2
1866	1	1	2	1	1	...	1	4	3	2	4	3

In June there are sixteen instances of no rainfall, four of which are in 1861, most frequently are three in number, the number of times being six. There are

JULY.

1861	...	2	3	3	3	3	2	2	2	4	5	4
1862	3	3	3	1	2	2	3	4	3	1	1	1
1863	...	1	1	1	1	2	2	3	2	1	...	...
1864	2	2	1	1	1	1	1	...	...	1	1	1
1865	1	1	...	1	1	3	2	2	2	2	2	4
1866	2	2	2	...	...	...	1	...	1	2	1	1

In the month of July there are thirty-five instances of no rainfall, three of 1866. The highest number of falls was five, of which there are two instances, four times.

AUGUST.

1861	4	2	1	2	2	1	...	...	...	...	1	1
1862	5	5	6	4	3	5	2	3	3	3	3	3
1863	1	1	2	3	3	2	2	2	3	3	1	1
1864	4	4	3	2	1	...	...	...	...	...	...	...
1865	2	5	1	2	4	4	2	1	3	4	3	1
1866	2	3	2	2	2	1	...	...	...	1	1	2

In the month of August there are twenty-four instances of no rain, eleven of The highest number of falls was six during the hour from 2h to 3h in 1862.

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Hour in every Month in the Years 1861–66 (*continued*).

MAY.

what Hours.												Years.
12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
3	2	1	2	2	1	2	1	1	2	2	1	1861.
3	2	3	3	4	5	2	1	2	3	3	4	1862.
2	2	2	3	2	2	1	3	3	2	2	1	1863.
4	3	3	3	1	1	2	2	2	2	1	1	1864.
1	2	2	2	3	3	3	5	4	1	2	1	1865.
2	5	4	2	2	1	1	2	1	1	1	1	1866.

are in 1861, four in 1863, one in 1865, and two in 1866. The hours in which five. There are eight instances of falling four times and twenty-six instances of

JUNE.

...	...	...	1	1	1	1	1	2	3	1	2	1861.
4	1	...	1	1	1	1	...	1	1	2	3	1862.
5	3	3	4	3	4	3	4	2	1	1	1	1863.
2	2	2	2	3	3	2	1	1	1	2	2	1864.
1	1	2	2	2	...	...	...	...	...	...	...	1865.
5	3	3	4	4	2	...	1	3	3	2	1	1866.

two in 1862, eight in 1865, and two in 1866. The hours in which rain fell fourteen instances of falling five times.

JULY.

2	2	1	2	3	2	...	...	1	2	2	3	1861.
1	2	2	5	2	2	3	2	1	1	2	3	1862.
...	...	...	...	...	...	1	1	1	...	...	1	1863.
1	1	...	...	...	1	1	1	1	1	...	...	1864.
3	1	2	4	4	2	2	2	1	...	1	1	1865.
...	...	1	1	1	...	...	...	...	...	...	3	1866.

which were in 1861, eleven in 1863, seven in 1864, two in 1865, and twelve in one in 1861 and one in 1862. There are six instances of rainfall amounting to

AUGUST.

...	...	...	...	...	1	2	...	...	1	2	3	1861.
1	2	3	2	1	2	2	3	3	1	1	3	1862.
...	...	1	1	1	2	3	2	1	1	1	1	1863.
1	1	1	1	1	1	1	1	1	1	3	4	1864.
2	2	1	...	1	3	2	3	5	4	1	3	1865.
2	3	2	2	4	3	2	3	5	2	1	1	1866.

which were in 1861, two in 1863, seven in 1864, one in 1865, and three in 1866. There are six instances of rain falling five times.

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TABLE I. Number of Times Rain fell during every

SEPTEMBER.

Years.	Between											
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.
1861	3	3	3	4	4	2	3	2	3	...	2	2
1862	1	3	3	4	5	4	3	2	3	5	5	3
1863	4	3	1	3	4	4	3	3	2	2	3	4
1864	3	3	3	3	3	4	3	3	2	2	3	5
1865	...	...	...	...	...	...	...	...	...	...	...	...
1866	4	4	4	4	3	2	2	2	4	2	1	1

In the month of September there are twenty-one instances of no rainfall, to 0·16 inch only. The highest number of falls was six, of which there are three

OCTOBER.

1861	2	2	3	3	2	1	...	1	2	1	1	...
1862	2	4	6	7	6	5	6	5	4	3	5	4
1863	3	5	6	7	4	2	2	...	...	...	1	1
1864	...	...	...	...	...	1	...	...	1	1	1	1
1865	3	1	4	4	3	3	4	4	4	5	5	4
1866	3	2	3	3	3	3	3	3	3	2	1	1

In October there are eighteen instances of no rain, three of which are in 1861, of falls was seven, of which there are two instances, one in 1862, and one in 1863.

NOVEMBER.

1861	6	5	5	3	4	4	4	3	3	2	1	2
1862	3	2	2	2	4	3	2	2	2	...	...	...
1863	4	3	2	...	1	1	1	2	1	1	1	1
1864	1	1	1	1	2	3	5	5	6	4	2	1
1865	...	...	1	1	1	3	3	1	2	3	...	1
1866	4	3	4	3	3	2	2	2	...	2	2	3

In November there are thirteen instances of no rainfall, three of which are in number of falls was six, of which there are four instances, three in 1861 and one

DECEMBER.

1861	1	1	2	2	2	2	1	...	...	1	1	1
1862	3	6	7	7	7	2	2	3	1	2	1	3
1863	...	1	2	2	1	1	...	1	1	1	1	2
1864	2	2	3	2	2	1	1	1	1	...	...	...
1865	1	...	1	...	...	1	1	2	1	2	2	1
1866	2	4	5	2	2	2	2	2	4	3	5	5

In the month of December there are twenty-two instances of no rainfall, three number of falls was seven, of which there are three instances, one instance of

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Hour in every Month in the Years 1861–66 (*continued*).

SEPTEMBER.

what Hours.												
12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	Years.
3	4	2	2	1	2	1	1	...	2	...	2	1861.
4	3	1	3	4	3	5	5	4	2	1	1	1862.
5	5	5	5	4	2	3	3	3	2	6	5	1863.
3	3	3	5	6	2	1	1	1	1	2	2	1864.
...	...	...	...	1	1	1	1	1	1	...	...	1865.
2	3	4	5	5	3	4	6	2	4	2	2	1866.

three in 1861, and eighteen in September 1865, in which month the fall amounted instances, and fourteen instances of falling five times.

OCTOBER.

2	1	1	1	1	2	2	1	3	1	...	3	1861.
4	3	2	2	3	3	4	6	6	5	2	4	1862.
2	4	3	2	2	1	3	3	3	2	2	2	1863.
2	1	2	1	3	3	1	...	1	1	...	...	1864.
3	3	1	1	3	3	4	4	4	4	...	1	1865.
1	...	1	1	2	1	2	3	2	2	2	3	1866.

three in 1863, ten in 1864, one in 1865, and one in 1866. The highest number There are six instances of falling six times, and seven instances of five times.

NOVEMBER.

2	3	2	2	3	3	3	4	4	6	5	6	1861.
1	3	2	2	2	3	2	2	1	1	3	2	1862.
1	1	2	2	1	...	2	2	2	2	4	4	1863.
3	2	5	3	3	3	2	...	2	2	...	1	1864.
3	2	2	2	1	2	1	2	1	2	3	2	1865.
1	1	2	1	3	3	1	...	...	1	1	1	1866.

1862, two in 1863, two in 1864, three in 1865, and three in 1866. The highest in 1864. There are six instances of falling five times and twelve of four times.

DECEMBER.

4	4	3	4	1	1	1	1	1	1	...	1	1861.
2	3	3	3	2	1	3	3	1	2	2	3	1862.
1	...	...	2	2	2	3	4	4	2	...	...	1863.
...	1	...	1	1	...	...	...	1	1	2	2	1864.
1	1	3	2	3	2	1	2	1	...	1	...	1865.
4	4	3	2	2	3	2	3	2	4	3	4	1866.

of which are in 1861, six in 1863, eight in 1864, five in 1865. The highest falling six times, and three of falling five times,

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TABLE II. Showing the total Number of Times Rain fell in every Hour of each Month in the Six Years (1861–66), and the average Number of times per Hour in each Month.

Month.	Between what Hours.																							Mean Number of times Rain fell per Hour.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
January.....	14	11	10	10	7	10	12	12	13	12	10	15	16	13	13	12	14	15	22	22	18	16	16	17	13·8
February ...	17	16	18	12	7	9	7	5	7	7	9	11	8	8	9	8	10	13	14	12	16	17	14	11	11·0
March	13	16	19	17	18	19	14	10	14	17	15	15	17	14	15	13	17	18	18	15	15	12	10	10	15·0
April	11	12	17	16	12	7	7	9	6	5	6	7	8	11	13	9	7	8	11	11	11	6	3	9	9·2
May	15	14	8	9	11	12	12	10	12	9	10	13	15	16	15	15	14	13	11	14	13	11	11	9	12·2
June	13	16	20	24	19	17	19	22	20	20	16	12	17	10	10	14	14	11	7	7	9	9	8	9	14·3
July	8	11	10	7	8	11	11	11	10	11	10	11	7	6	6	12	10	7	7	6	5	4	5	11	8·4
August	18	20	15	15	15	13	6	6	9	11	9	8	6	8	8	6	8	12	12	12	15	10	9	15	11·0
September...	15	16	14	18	19	16	14	12	14	11	14	15	17	18	15	20	21	13	15	17	11	12	11	12	14·9
October	13	14	22	24	18	15	15	13	14	12	14	11	14	12	10	8	14	13	16	17	19	15	6	13	14·2
November ...	18	14	15	10	15	16	17	15	14	12	6	8	11	12	15	12	13	14	11	10	10	14	16	16	13·1
December ...	9	14	20	15	14	9	7	9	8	9	10	12	12	13	12	14	11	9	10	13	10	10	8	10	11·2

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From the numbers in this Table, the hour or hours of most frequent rain in the different months were as follows:—

		h		h		h		h			
In January ...	from	18	to	19	and	19	to	20	being	22	in number.
February	„	2	„	3					„	18	„
March ...	„	2	„	3	„	5	„	6	„	19	„
April	„	2	„	3					„	17	„
May	„	13	„	14					„	16	„
June	„	3	„	4					„	24	„
July	„	15	„	16					„	12	„
August ...	„	1	„	2					„	20	„
September	„	16	„	17					„	21	„
October ...	„	3	„	4					„	24	„
November	„	0	„	1					„	18	„
December	„	2	„	3					„	20	„

From these numbers it appears that, in the year, rain fell most frequently between the hours of 3 P.M. and 4 P.M. in the months of June and October.

The hour or hours of least frequency in the different months are as follows:—

		h		h	h	h			
In January ...	from	4	to	5	.....		being	7	in number.
February	„	7	„	8	.....		„	5	„
March.....	„	7	„	8, 22 to 23, and 23 to 24	...		„	10	„
April	„	22	„	23	.....		„	3	„
May.....	„	2	„	3	.....		„	8	„
June	„	18	„	19 and 19 to 20			„	7	„
July.....	„	21	„	22	.....		„	4	„
August ...	„	6	„	7, 7 to 8, 12 to 13, and 15 to 16			„	6	„
September	„	9	„	10, 20 to 21, and 22 to 23			„	11	„
October ...	„	22	„	23	.....		„	6	„
November	„	10	„	11	.....		„	6	„
December	„	6	„	7	.....		„	7	„

Rain seems to have fallen the least frequently in the year between the hours of 10 A.M. and 11 A.M. in April; and the next in order is the hour of 9 A.M. to 10 A.M. in July.

On looking over the numbers in this Table, it is at once seen that the hours of greatest frequency of rain in one month are not those of other months.

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By comparing the numbers in the last column, representing the average number of falls from all the hours in each month, it will be seen that there are groups of hours with smaller numbers than the average, and other groups of hours with numbers larger than the average, implying dry and wet periods of several hours' continuance in the twenty-four hours in every month; but these periods are different in the different parts of the year.

In January, the three consecutive hours of greatest excess of frequency are 18^h to 21^h (6 A.M. to 9 A.M.), their sum of excess above the average is 20; those of greatest deficiency are 2 P.M. to 5 P.M. and 3 P.M. to 6 P.M., their sum of deficiency below the average is 14. All hours from 1 P.M. to 11 P.M. show less frequency than the average; and the remaining hours, with trifling exceptions, are in excess. The dividing hours are about noon and midnight.

In February, the three consecutive hours of greatest excess of frequency are noon to 3 P.M., their sum being 18 above the average; whilst those of greatest deficiency are 6 P.M. to 9 P.M. and 7 P.M to 10 P.M., their sums being 14 below the average; and generally from 4 P.M. to 5 A.M. the frequency of rain is less than the average for the month, and greater during the remaining hours.

In March, the three hours 2 P.M. to 5 P.M. and from 3 P.M. to 6 P.M. are those whose sums are the greatest above the average, being 9; whilst the least frequent are the three consecutive hours preceding noon, their sum being 13 below the average. The period of least frequency of rain was from 7 A.M. to 1 P.M., during which time, at two hours (7 A.M. to 9 AM.), there was the average frequency, but less so at the other hours; from 2 P.M. to 6 P.M. the frequency of rain was above the average; it was generally less from 6 P.M. to 4 A.M., and in excess from 4 A.M. to 7 A.M.

In April, the three consecutive hours of greatest frequency were from 1 P.M. to 4 P.M. and 2 P.M. to 5 P.M., and of least from 8 P.M. to 11 P.M.; the period of least frequency was from 5 P.M. to 6 A.M., or during the night, and of greatest frequency, during the day hours.

In May, the three consecutive hours of the greatest frequency were those following midnight; and the least were those following 2 P.M. The periods of least frequency, generally were from 2 P.M. to 11 P.M., and the most frequent in the ten hours following 11 P.M.

In June, the three consecutive hours of greatest frequency were from 2 P.M. to 5 P.M.; and of least from 6 A.M. to 9 A.M. The hours from 1 A.M. to 1 P.M. were those distinguished by the least

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frequent, and the remaining eleven hours by the most frequent rain.

In July, the three consecutive hours distinguished by the most frequent rain were 5 P.M. to 8 P.M.; and those of least frequency 8 A.M. to 11 A.M.; and generally rain was less frequent in the twelve hours following midnight, than in the twelve hours preceding it.

In August, rain fell most frequently in the three hours following noon; and the least frequently in the three hours following 6 P.M. Generally rain fell the most frequently from 11 A.M. to 6 P.M., and was generally below the average at other hours, but particularly so from 6 P.M. to 5 A.M., the number, at every hour, within this period, being less than the average.

In September rain was most frequent in the three hours following 2 A.M.; and least from 8 A.M. to 11 A.M. The frequency was generally less than the average between 5 A.M. and 8 P.M., and again between 1 P.M. and midnight, the other hours being in excess of average.

In October, the three hours of most frequent rain were from 2 P.M. to 5 P.M., and of the least frequent from 1 A.M. to 4 A.M. The longest of less than average frequency were the night hours from 7 P.M. to 6 A.M., and during the day hours, with the exception of 10 A.M. to 1 P.M., were generally in excess over the average frequency.

In November, the three hours from 4 P.M. to 7 P.M. and from 5 P.M. to 8 P.M. were distinguished by most frequent rain; and the three hours from 10 P.M. to 1 A.M. by the least. And generally rain fell the least frequently in the twelve hours following 9 P.M., and most frequently in the twelve hours following 9 A.M.

In December, the three consecutive hours of greatest frequency were from 1 P.M. to 4 P.M., and from 2 P.M. to 5 P.M.; and those of least frequency from 6 P.M. to 9 P.M. The month is distinguished by periods of alternate excess and deficiency of frequency; from 1 P.M. to 5 P.M. the frequency is in excess; then deficient from 5 P.M. to 11 P.M.; in excess from 11 P.M. to 5 A.M., and frequency generally below the average from 5 A.M. to 1 P.M.

From these particulars of each month, it will be seen that the most frequent rain, in three consecutive hours, took place in October, from 2 P.M. to 5 P.M.; the next in order was in June, also between the hours of 2 P.M. and 5 P.M.; that the three con-

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secutive hours of least frequency in the year were in June, between 6 A.M. and 9 A.M.

It also appears that the long period of least frequency of rain was in the afternoon and early night hours in January and May; was from about sunset, or early evening hours to the early morning hours in February, March, April, August, October, November, and December; that in June and July it was in the eleven or twelve hours preceding noon; in May, was from 2 P.M. till nearly midnight; but in September, a month differing from all the rest, it was from 5 A.M. to 3 P.M.: that in March and December there are two other periods of little frequency, in March from 7 A.M. to 1 P.M., and in December from 5 A.M. to 1 P.M. It would therefore seem that the times of greatest and least frequency of rain form in groups of hours, but that these groups of hours in one season are not those of other seasons.

By combining the numbers in Table II. according to seasons, considering November, December, and January as winter; February, March, and April as spring; May, June, and July as summer; and August, September, and October as autumn, the next Table is formed:—

TABLE III. Showing the Frequency of Rain at every Hour in the Periods of Winter, Spring, Summer, and Autumn.

Seasons.	Between what Hours.																								Mean Number of Times.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
Winter.	41	39	45	35	36	35	36	36	35	33	26	35	39	38	40	38	38	38	43	45	38	40	40	43	38·1
Spring..	41	44	54	45	37	35	28	24	27	29	30	33	33	33	37	30	34	39	43	38	42	35	27	30	35·2
Summer	36	41	38	40	38	40	42	43	42	40	36	36	39	32	31	41	39	32	26	28	28	25	24	29	34·9
Autumn	46	50	51	57	52	44	35	31	37	34	37	34	37	38	33	34	42	37	42	45	44	36	26	40	39·9

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It is evident from these numbers that there is a marked difference in the frequency of rain in the different seasons of the year.

In *Winter* it falls most frequently in the hours from 2 P.M. to 3 P.M. and 7 A.M. to 8 A.M., and least frequently in the hour from 10 P.M. to 11 P.M. Its frequency is most general, or above the average, from 6 A.M. to 3 P.M., and least so, or below the average, at all hours from 3 P.M. to 6 A.M., with the exception of the hours following midnight and that following 2 A.M.

In *Spring* rain falls most frequently in the hour from 2 P.M. to 3 P.M., and least frequently from 7^h to 8^h in the evening. The periods of excess of frequency above the average are from 5 A.M. to 9 A.M. and from noon to 5 P.M.; those of less frequency than the average from 5 P.M. to 5 A.M., during which, at every hour excepting that following 2 A.M., the frequency of rain is less than the average.

In *Summer* rain fell most frequently in the hours between 1 P.M. and 2 P.M., from 5 P.M. to 10 P.M., and between 3 A.M. and 4 A.M. It is in excess of the hourly average at all hours from noon to 1 A.M. and between 3 A.M. and 5 A.M. The frequency of rain is below the average between the hours 1 A.M. to 3 A.M., and very remarkably so from 5 A.M. to noon. It falls the least frequently in the two hours from 9 A.M. to 11 A.M.

In *Autumn* rain falls most frequently between the hours of 10 A.M. and 11 A.M. The frequency is in excess over the average, from noon to 6 P.M.; is in defect of the average from 6 P.M. to 4 A.M., without exception; is again in excess from 4 A.M. to 9 A.M., and in defect from 9 A.M. to 11 A.M., and about the average in the hours before noon. In some respects, therefore, the distributions of the frequency of rain in the periods of winter and summer, during the twenty-four hours of the day, are directly opposite to each other; whilst that of spring and autumn are nearly in agreement.

Speaking generally, the periods of rainfall in winter are during the morning and afternoon hours,—essentially in the day.

In spring during the afternoon and early morning hours.

In summer during the afternoon hours till after midnight.

In autumn during the afternoon and early morning hours.

The next Table is formed by dividing the twenty-four hours into eight groups of three hours each, reckoning from noon, the excess or defect above or below the average of each period being in-

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dicated by the numbers to which the sign + or — are affixed respectively.

Seasons.	Number of Times Rain fell during the Period.							
	0^h to 3^h.	3^h to 6^h.	6^h to 9^h.	9^h to 12^h.	12^h to 15^h.	15^h to 18^h.	18^h to 21^h.	21^h to 24^h.
Winter	125	106	107	94	117	114	126	123
Spring	139	117	79	92	103	103	123	92
Summer.....	115	118	127	112	102	110	79	77
Autumn.....	147	153	103	105	108	115	134	103
	Excess or Defect above or below the average Number of Times.							
Winter	+10·7	− 8·3	− 7·3	−20·3	+ 2·7	− 0·3	+11·7	+ 8·7
Spring	+33·4	+11·4	−26·6	−13·6	− 2·6	− 2·6	+17·4	−13·6
Summer.....	+10·3	+13·3	+22·3	+ 7·3	− 2·7	+ 5·3	−25·7	−27·7
Autumn.....	+27·3	+33·3	−16·7	−14·7	−11·7	− 4·7	+14·3	−16·7

From these results it appears that rain falls most frequently in the year—

In winter in the six hours preceding and the three hours following noon.

In spring in the three hours following noon.

In summer in the three hours following 6 P.M.

In autumn in the six hours following noon, and which are the most frequent of any in the year.

That it falls the least frequently—

In winter in the three hours preceding midnight.

In spring in the three hours from 6 P.M. to 9 P.M.

In summer in the six hours before noon, and which are the least frequent of any in the year.

In autumn in the three hours preceding noon, and from 6 P.M. to 9 P.M.

The excess or defect of each period above or below the average is shown in the second division of the Table; the number with the largest + sign shows the three hours of greatest excess; and in like manner, the largest number with the — sign affixed shows the period of greatest deficiency in each period; and the other numbers show the deficiency from the average at the other period.

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By dividing the day into four periods of six hours each, starting from 0^h (noon), the following Table is formed:—

Seasons.	Number of Times Rain fell during the Period.				Excess or Defect above or below the average Number.			
	0^h to 6^h.	6^h to 12^h.	12^h to 18^h.	18^h to 24^h.	0^h to 6^h.	6^h to 12^h.	12^h to 18^h.	18^h to 24^h.
Winter	231	201	231	249	+ 2·4	−27·6	+ 2·4	+20·4
Spring	256	171	206	215	+44·8	−40·2	− 5·2	+ 3·8
Summer.....	233	239	212	156	+23·6	+29·6	+ 2·6	−53·4
Autumn.....	300	208	223	237	+60·6	−31·4	−16·4	− 2·4

These results show that rain fell most frequently in the fourth quarter in winter, in the first in spring and autumn, and in the second in the summer.

It fell the least frequently in the second quarter in winter, spring, and autumn, and in the last quarter in summer.

The smallest number in the Table is in the fourth quarter in summer, and the largest in the first quarter in autumn.

The excess or defect above or below the respective averages of the seasons, are shown in the second division of the Table:—

In winter the largest excess appears in the fourth quarter.
In spring „ „ „ first quarter.
In summer „ „ „ second quarter.
In autumn „ „ „ first quarter.

And
In winter the largest defect appears in the second quarter.
In spring „ „ „ „ „
In summer „ „ „ fourth quarter.
In autumn „ „ „ second quarter.

By dividing the twenty-four hours into twelve-hour groups, 0^h to 12^h (noon to midnight) for one, and 12^h to 24^h (midnight to noon) for a second, 18^h to 6^h (6 A.M. to 6 P.M.) for a third, and 6^h to 18^h (6 P.M. to 6 A.M.) for a fourth, the following Table is formed:—

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Seasons.	Number of Times Rain fell during the Period.				Excess or Defect above or below the average Number.			
	0^h to 12^h.	12^h to 24^h.	18^h to 6^h (day).	6^h to 18^h (night).	0^h to 12^h.	12^h to 24^h.	18^h to 6^h.	6^h to 18^h.
Winter	432	480	432	480	−25·2	+22·8	−25·2	+22·8
Spring	427	421	377	471	+ 4·6	− 1·4	−45·4	+48·6
Summer.....	472	368	451	389	+53·2	−50·8	+32·8	−29·8
Autumn.....	498	460	433	535	+29·2	−18·8	−45·8	+56·2

It appears here that the frequency of rain in the twelve hours ending at noon was smaller in the period of spring, summer, and autumn, and larger in winter than in the twelve hours ending at midnight.

And the frequency in the twelve hours ending 6 A.M. (the period of night) was greater in winter, spring, and autumn, and smaller in summer, than in the day period, or the twelve hours ending at 6 P.M.

In winter it seems that the frequency of rain in the twelve hours ending at midnight is the same as that ending at 6 P.M.; and likewise that ending at midnight is the same as that ending at 6 A.M.

The frequency of rain in twelve-hourly periods is very different in the different seasons; their excesses or defects above or below their respective averages are shown in the second division of the above Table.

In winter the difference is considerable

In spring the difference is small in the two twelve-hour periods dividing at noon and midnight; but is very large in those dividing at 6 A.M. and 6 P.M.; in the day period there appears a deficiency of 45, whilst in the night an excess as large as 49, nearly.

In summer there is a great difference in the frequency; in the first period appears 53 in excess, whilst in the second, the defects amount to 51, nearly.

In autumn, like spring, there is a great excess in the night period over that of the day.

By taking the sums and the means of the numbers in Table II., at every hour, we find—

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From	h 0	to	h 1	total number 161	the mean per hour	13·7
	1	„	2	„ 171	„ „	14·5
	2	„	3	„ 188	„ „	15·7
	3	„	4	„ 177	„ „	14·7
	4	„	5	„ 163	„ „	13·6
	5	„	6	„ 154	„ „	12·8
	6	„	7	„ 141	„ „	11·7
	7	„	8	„ 134	„ „	11·2
	8	„	9	„ 141	„ „	11·7
	9	„	10	„ 136	„ „	11·3
	10	„	11	„ 129	„ „	10·7
	11	„	12	„ 138	„ „	11·5
	12	„	13	„ 148	„ „	12·3
	13	„	14	„ 141	„ „	11·7
	14	„	15	„ 141	„ „	11·7
	15	„	16	„ 143	„ „	11·9
	16	„	17	„ 153	„ „	12·7
	17	„	18	„ 146	„ „	12·1
	18	„	19	„ 154	„ „	12·7
	19	„	20	„ 156	„ „	13·0
	20	„	21	„ 152	„ „	12·6
	21	„	22	„ 136	„ „	11·2
	22	„	23	„ 117	„ „	9·7
	23	„	24	„ 142	„ „	11·8

As might be expected from the facts stated in the earlier part of this paper, that the frequency of rain was different during the day and night at different parts of the year, these numbers differ less among themselves than do similar numbers for parts of the year—still they show considerable difference.

The average frequency of rain at the different hours during the whole year is shown by the last column; among them the largest number is between 2 and 3 P.M., implying the hour of most frequent rain during the whole year; the hour of least frequent rain is the last but one, between the hours of 10 A.M. and 11 A.M.

The most continuous large numbers are in the five hours following noon; and these are by far the most rainy hours.

The hours of least frequency are the three hours preceding noon; and the next in order of least frequency are the three hours preceding midnight.

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The hours of 10 to 11 A.M., and 10 to 11 P.M., are the two hours distinguished by the least frequent falls of rain.

The numbers in the last column, multiplied by 2, agree with those in Table XIII. of my paper in the last Number of the Proceedings, and thus confirm the accuracy of both investigations up to this point. It is my intention, at a future Meeting, to bring before this Society the amount of rain, at the different times of day, with different months and seasons of the year.

VI. *November Meteors*, 1867.

European Account.—Royal Observatory, Greenwich.

The watch for luminous meteors at the Royal Observatory, on November 13th, commenced immediately after dusk, although the sky was then overcast, and gave but little promise of becoming clear. By 7 P.M. a few breaks in the clouds were discerned in the zenith, and by 8 P.M. the sky was cloudless and remained so till $0^h\ 20^m$ A.M. of the 14th. During this clear period twelve meteors were observed, of which six were seen between the hours of 8 P.M. and 11 P.M., and six between 11 P.M. and $0^h\ 30^m$ A.M. At midnight the atmosphere was very cold; hoar frost was deposited, and at the height of 10 feet above the ground (on the roof of an exposed shed) ice was formed on shallow pools of water. About $0^h\ 20^m$ A.M. detached fragments of light cloud were seen in different directions, and at $0^h\ 30^m$ A.M. clouds came up from the S., which speedily covered the sky; and it was overcast till 4 A.M., with scud passing over continually.

The sky now became partially clear, remaining so till $4^h\ 30^m$ A.M.; and three meteors were observed; but after $4^h\ 30^m$ A.M. the sky again became overcast, and no further change took place till daybreak.

The readings of the barometer had decreased steadily throughout the morning of the 14th; and the reading at noon exhibited a decrease of no less than a quarter of an inch as compared with the reading at 9^h on the previous night; and the sky was covered with dense clouds throughout the day, whilst rain fell in occasional showers. Under these conditions there appeared but scant

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hope of any meteoric display being seen on the night of the 14th and morning of the 15th; but, nowise disheartened, the observers were again in attendance for observation throughout the morning hours of the 15th. Between 9 P.M. on the 14th and 1½ A.M. on the 15th, a variable amount of cloud was prevalent; but after 1½ A.M. the sky became cloudless, and remained so, with slight exceptions, till 6 A.M. Between these hours, thirty meteors of large size were seen, of which twenty-six were of a bluish colour, and four yellow. It is to be remarked that, possibly, many meteors of small size were lost to view on account of the brilliancy of the moon, and also that (from the same cause) those seen are probably referred to standards of comparison of less size than those which would have been employed had the moon's light been absent.

The observers on November 13–14 were Messrs. Nash, Harding, F. Trapaud, Jones, T. Wright, and G. Farncomb; and on November 14–15, Messrs. Nash, Harding, and Wright.

W. H. WOOD, Esq., Birmingham.

The persistent overcast skies on and preceding the 12th broke off at 7 P.M. of the latter date, and exhibited a considerable portion of clear sky until 9 P.M., when the clouds again gathered, presenting an unbroken densely overcast sky during the succeeding twenty-seven hours. No meteors were observed in the favourable interval. Shortly after midnight of the 13th, the dense mass of clouds commenced clearing, leaving the sky free of cloud from 1 till nearly 3 A.M., with a trifling exception, disclosing 2nd and 3rd magnitude stars. Some observations were taken between 12^h and $12^h\,30^m$ in the clear spaces, a prevailing haze until near 1 A.M. rendering all below the 1st magnitude stars indistinct, but not altogether unfavourable for observations. At 2.45 A.M. vapour began to spread over the heavens, so rapidly increasing in density that by 3 A.M. the sky had resumed its previous impenetrable condition, remaining without change until 7 A.M., when it was augmented by a dense mist subsequently followed by rain, increasing at midnight and even continuing through a considerable portion of the early hours of the 15th.

The hourly number of meteors was singularly *stationary* at three

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meteors per hour for each individual hour from 12 till 3 A.M.; and, assuming 3 A.M. to be four hours from the maximum, the present display represents a diminution of less than one-fourth that of November 1866, similarly contrasted. There was an absolute interval of one hour, from 0.55 to 1.55 A.M., which produced no meteors, every condition being favourable. The few meteors observed gave results apparently distinct from those of the previous shower, by excess in apparent velocity, difference in colour, and an absence of meteors below 1st magnitude stars.

General colour white, or bluish-white; general apparent size, larger than 1st magnitude stars; average duration, ·6 of a second; radiant L; hourly number, three.

Hour of observation.	No. of Meteors observed.	State of the weather.
From 12 h to 1 h A.M.	3	Detached clouds till 12.30, then hazy till 1 A.M. 1st magnitude stars visible.
1 h „ 2 h „	3	Bright moonlight; sky clear. 2nd and 3rd mag. visible.
2 h „ 3 h „	3	Same as above till 2.45; overcast at 3, 4, 5, 6, and 7 A.M.

R. P. Greg, Esq., F.G.S., Manchester.

The night past was very unfavourable in this neighbourhood for seeing meteors, owing to the bright moon and fogginess. I did not see a single meteor from 11 P.M. till 2 A.M., about half the sky being tolerably clear. After that, the sky became more and more thickly covered; and after 3 o'clock not a star, fixed or shooting, was to be seen.

F. Webb, Esq., St. Peter's, near Margate.

At 4 A.M. of the 14th, or, more correctly, at $13^d\ 16^h$, I placed myself in a window facing, on one side, the E.S.E., and on the other the S.S.W.

The sky to the south (from S.E. to W.) was thick, obscuring 20° from the horizon. A filmy cirrus or striated cloud overspread the sky, leaving it bright and clear to the N. and E.; all

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the stars of the principal constellations, the Moon, Sirius, and Regulus, were very bright.

Wind S.E. (force 3).

Barometer 29·865 in.

Thermometer (lowest) 41°.

The following is the result, G. M. T., civil time, omitting seconds, 14th of November, 4h 43m A.M., meteor 10° above E., horizon from E.S.E. to E.N.E.

5h 17m A.M., do. do., but a little higher.

These two were not well seen, some trees intervening (doubtful).

At 5h 30m A.M. I left the window and went into the garden; the sky was thickening from the south and west; but the region of Leo and the N.E. were still tolerably clear.

At 5h 53m A.M., bright meteor to N.E., followed by two others equally bright in the zenith, course nearly due north. A fourth, in the N.E., nearly in the same place as the first.

A fifth, in the S.E., falling at an angle of 70° to the horizon.

A sixth, due south, falling perpendicularly for a short distance.

These six meteors were all observed between 5h 53m A.M. and 6 A.M., at nearly equal intervals; but I could not see a watch, as the sky was thickening, and the moon obscured.

They all (except the last) seemed to travel over from 20° to 30°; one, in the zenith, perhaps 40°. The last fell, like a tear, out of Regulus; and the path of all was distinctly traceable to the point in Leo which was observed last year.

Having witnessed the magnificent display of last year, I now began to hope that a repetition of it was about to take place; but I saw but one more, at 6h 22m A.M., due south, and falling almost perpendicularly, of about the same brilliancy and duration as the first (making seven in all). I remained on the ground till 6.50 A.M.; by this time the sky was nearly overcast, and day rapidly dawning; still, I think I should have seen any star falling of the same brilliancy as that seen at 6.22 A.M., had it appeared before 6.45 A.M. To the S.W. I could have seen nothing. I should have concluded that the observations were interrupted by the overcast sky and dawning light, had I not seen that at 6h 22m A.M., after an interval of twenty-two minutes; I was therefore led to believe that we only passed through the outskirts of the cosmical bodies whose orbit we encountered so fully last year.

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GEORGE YOUNG, Esq., Ramsgate.

Being at Ramsgate, I availed myself of the fine evening previous to the 14th and the morning of that day, to look out for the November meteoric shower, all which period was very fine mild weather here.

After dark on the 13th, an occasional one was seen during the evening, but at long intervals, say half an hour.

From 3^h in the morning of the 14th to 5^h, I looked from a favourable large window commanding the E., S., and W., occasionally going to the north window, to see if I could observe any, but I could not see any.

At 5 A.M. I went out of doors on to the Esplanade, commanding an extensive horizon of all points, on which a Coast-Guardsman perambulates during the night; on my speaking to him, he told me he had kept a good look-out from midnight, and had only seen five shooting-stars; from 5 to $6\frac{1}{2}$, I saw, perhaps, eight or nine; and after that, until 7, none, although the morning was very fine; after 6, fog arose in the west, obscuring one-third of the horizon in that direction; several of the stars I saw, shot from the constellation of Leo.

Two of the meteors were first-class, one at $5^h\ 20^m$, the other at $6^h\ 5^m$ A.M.

From 5 to 6.15 A.M. of the 14th, was evidently the period when the majority appeared, their inclination being from Leo to N. and N.E.

I have been here two months on the 19th; the weather here has been unusually fine and dry, as compared to the rest of England, not half an hour's rain having fallen during the day during that period, and seldom during the night a shower.

C. H. WESTON, Esq., Bath.

Fog commenced early in the evening, increased in density, and continued throughout the night.

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Prof. A. HERSCHEL, Glasgow.

We had no star-shower here, but rain and thick clouds the whole night through.

Sir JOHN HERSCHEL, Bart., Collingwood, Hawkhurst, Kent.

Up to 10 A.M. bright moon; so bright that only one or two stars, 1st magnitude, were visible. It became more and more foggy; at 11 P.M. dense fog, and some drift passing over the moon.

At 12¼, fog bad, and cloud spreading over the sky, so that the moon could scarcely be seen; grew worse and worse up to 2 A.M.

At $2^h\ 5^m$, Mr. Birkbeck saw a most superb meteor. He describes it as much the largest he ever saw, comparable to the moon. It must have been in a comparatively clear interval; for he describes it as going obliquely down from a high point between two stars (Castor and Pollux, no doubt) to below the Great Bear. Its train was perceptible. It could not have been one of the November meteors. The watch was kept up by one of the ladies till 5 or 6 o'clock; and two or three meteors were seen through or among the clouds, and some gleams, as of meteors, behind clouds.

M. W. DE FONVIELLE, Paris. Balloon Ascent for Observations.

M. W. de Fonvielle, in a series of articles contributed to 'La Liberté' (November 17 to 28), describes a balloon ascent undertaken by him on the night common to November 14–15, for observation of the expected shower of luminous meteors. From a great mass of altogether irrelevant matter which forms the bulk of his articles, the following information relating to the objects of the ascent and the meteoric observations made on that occasion, is extracted.

"The special end I had in view to attain by means of the balloon, was to give a first notice to astronomers of the means they ought to adopt to observe the shooting-stars of the 13–14th of November."

"Although the scientific ascent I had planned for the night of the 13–14th only took place on that of the 14–15th, I feel that I

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have succeeded in a more complete manner than I had dared to hope."

The lightness of the gas, which had been specially prepared for this occasion by M. Giffard, the owner of the balloon, rendered it capable of raising three persons; whilst, under ordinary circumstances, two travellers could scarcely be carried. The three persons who participated in this ascent, were M. W. de Fonvielle, M. Jules Godard, the noted aëronaut, under whose guidance the balloon was placed, and M. Alfred von Wayenberch, a Belgian engineer.

About midnight Godard gave notice of a very faint shooting-star, that probably would not have been seen on the earth, and which 500 mètres of elevation (1640 feet) sufficed to show to those in the balloon; and from this time M. de Fonvielle begins to breathe freely the pure air of that elevated region, feeling sure that he would not now return to the earth "cheated" of the exhibition, as he had feared might be the case.

M. de Fonvielle sums up the night's observations as follows:—"We saw meteors twelve or thirteen times during the night. Once I thought I caught two at once, less brilliant, and of very short duration. Later I thought we had met with a crowd. Godard cried out that he saw one the size of a hand, and the Belgian engineer also."

"But I only attach importance to three observations that I made at the same time as one of my companions. These, seen by two observers, appeared all three between the Great Bear and the constellation Leo, represented by Regulus, which was visible in spite of the efforts of the moon. They were very bright, and of bluish light, appearing without any transition, and disappearing with the same rapidity. They were not accompanied by any perceptible noise, and crossed a light curtain of cloud. The length of time of their appearance was about a second; and I should consider their mean brilliancy as equal to that of Sirius. The length of the arc described by these meteors was about 10°. The first appeared about 3 A.M., and the last towards 5½ A.M. All three undoubtedly belonged to the radiant-point of the November meteors; and I should be very curious to know if the observers at the Imperial Observatory were able to observe them."

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Prof. DENZA, Moncalieri, Italy.

I have the honour to send you some information as to what has been done here during the return of the November period of shooting-stars. In those districts where, at my instance, zealous observers have formed themselves, as it were, into a private society, the heavens had to be observed from many places, the principal of which were Turin, Moncalieri, Bru, Mondon, and Varallo; and all was so arranged that the observations should be taken in a uniform manner and at the same time, to be able to verify, not only the return of the period, but also all other circumstances which tended most to confirm the theories which are at present in force on this curious and interesting phenomenon.

Observations had to be taken everywhere on the evenings of the 12th, 13th, and 14th; in some places even, as at Moncalieri, they were commenced from the 10th; but the presence of our satellite, the very slight, in fact no transparency of the air, and above all, the bad weather and a very thick fog, totally hindered the observations; and we all had the misfortune, which astronomers must always expect, of gathering no fruit from our labours after having made much preparation.

However, the observations that could be made in different localities during the first hours of the night of the 13-14th, and even some hours after midnight (for during this time the sky here and there was clear), led us to believe that the concourse of meteors this year was very different to that of last year; because nothing was seen, or with difficulty some solitary meteor could be observed; and at Movalier, where the fog had a little dispersed, there was only seen on the 14th, towards 5 o'clock in the morning, one magnificent bolide, which, coming from the constellation Leo, brightly illuminated all the fog which lay beneath.

If this fact should be confirmed by observations made elsewhere, we must conclude that the maximum of the period took place last year, and that consequently its duration is thirty-three years and a quarter; and as the display of last year was less considerable than that of 1833 and of 1799, the years of the illustrious Director of the Observatory, Brera, would thus be confirmed; that is to say, the cloud or current of November meteors becomes continually longer in its orbit, so that, while it increases in length, it loses in its other dimensions.

From this it results that this display will become continually

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always less continuous, like that of the month of August, which is seen every year, but will always lose in interest and will be less and less considerable. But to affirm this with certainty, we must wait for the result of the observations made, not only in Europe, but also in America.

According to information that I have received from different places in Italy, I learn that throughout northern and southern Italy nothing has been seen in consequence of the bad weather.

At Palermo, more than 100 meteors were seen on the morning of the 14th.

Governor R. M. Rawson, C.B., Nassau, N. P. Bahamas.

Lat. 25° 5′ N., long. 77° 22′ W.

I have pleasure in forwarding to the Society a Table showing the character of the meteoric shower as observed here, on the morning of the 14th of November. The observer was not advantageously placed for an extensive view of the heavens; and two other observers, in a better position, counted 1100 meteors between $2^h\ 30^m$ A.M. and $4^h\ 45^m$ A.M., up to which time Captain Stuart had counted only about 800. They were observed all round the heavens from N.W. to S., and some overhead. From 4 A.M. the meteors appeared to radiate principally from a centre a little to the S.E. of the zenith, and shot in all directions.

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Observations with regard to the Meteoric Shower at Nassau, N. P., Bahamas (lat. 25° 5′ N., long. 77° 22′ W.), on the morning of November 14th, 1867. By Captain Stuart.

Time of Observation.	Number of Meteors observed.			Meteorological observations.						Remarks.
	In each Period.	In each Hour.	In the whole Period.	Time of Observation.	Barometer.	Dry-bulb Thermometer.	Wet-bulb Thermometer.	Direction of the Wind.	Amount of cloud 0–10.	
				h	in.	°	°			
From 1 h 0 m A.M. to 1 h 50 m A.M.	3	5		1 A.M.	30·170	72	69	N.E.		1h 32m A.M. A meteor about 20° E. by N. from Sirius, whose altitude was 43°. Direction from N. to S.
,, 1 50 ,, 2 0 ,,	2									
,, 2 0 ,, 3 0 ,,	17	17		2 A.M.	30·175	72·7	68	...	5	
,, 3 0 ,, 3 15 ,,	23			3 A.M.	30·160	71·5	67			1h 45m A.M. A meteor 10° E. by N. from Polaris. Altitude 25°; N. to S.
,, 3 15 ,, 3 30 ,,	52	190								1h 50m A.M. In the Great Bear. E. to W.
,, 3 30 ,, 3 40 ,,	32									The proportion of sky visible to the observer, who was only a few feet above the level of the sea, was about 6.
,, 3 40 ,, 3 50 ,,	34									
,, 3 50 ,, 4 0 ,,	49									
,, 4 0 ,, 4 10 ,,	118		1040	4 A.M.	30·150	71	67	...	4	
,, 4 10 ,, 4 15 ,,	125									The moon shone very brightly between 3h 45m A.M. and daybreak. She was about 30° W. of that part of the heavens where the meteors were chiefly seen.
,, 4 15 ,, 4 20 ,,	102									
,, 4 20 ,, 4 25 ,,	73									
,, 4 25 ,, 4 30 ,,	69	690								
,, 4 30 ,, 4 35 ,,	66									
,, 4 35 ,, 4 40 ,,	21									The direction of the meteors was N. to S. and E. to W. chiefly near the constellation of Ursa Minor at altitude of 45°.
,, 4 40 ,, 4 50 ,,	52									
,, 4 50 ,, 5 0 ,,	64									
,, 5 0 ,, 5 10 ,,	65			5 A.M.	30·150	70·5	67·5	N.E.	2	No atmospheric or magnetic disturbance was caused by the meteors while falling.
,, 5 10 ,, 5 20 ,,	22	34m.								
,, 5 20 ,, 5 30 ,,	46	138								
,, 5 30 ,, 5 34 ,,	5									

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ST. GEORGE, GRENADA (*from the* 'St. George's Chronicle').

On Thursday the 14th of November, before daybreak, was observed a shower of luminous meteors in the heavens, flying about in every direction and of every conceivable magnitude. We first observed this strange yet beautiful phenomenon at about 4½ A.M.; and it continued up to 5½ A.M., even when daylight had fairly set it.

G. T. KINGSTON, Esq., M.A., University Observatory, Toronto, Canada.

I send a brief statement of our observations on the November meteors to the present time.

A watch was kept through the night of Tuesday November 12; but the sky was perpetually overcast.

November 13–14. Prior to 1 A.M. on Thursday November 14 the sky was nearly overcast, and about twenty meteors only were seen between midnight and 1 A.M.

At $1^h\ 10^m$ A.M., systematic counting was commenced from the top of the tower of the Observatory by four observers working simultaneously. The observers were graduates and students of University College, Toronto, a large number of whom remained in the building through the night, relieving each other from time to time till 6 A.M.

The bright moonlight throughout the night, and the clouded state of the sky before 1 A.M., greatly interfered with the display. But for these causes the number would probably have been doubled.

Nearly all the meteors proceeded in directions which, when produced backwards, passed through the constellation of Leo, only about 2 per cent. being not conformable to that course.

Many of them, in spite of the moonlight, were very brilliant; but there were no audible explosions.

The following Table shows the number of shooting-stars observed during each interval of ten minutes, together with a column showing the average amount of cloud during the said interval, as derived from the cloudiness at the beginning and ending of each ten minutes' interval.

November 14–15. On the night of November 14 the sky was nearly overcast till 4 A.M. of the 15th, but with an amount of clear space sufficient to have betrayed the existence of meteors if they had been numerous.

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Between 3 A.M. and 4 A.M. on Friday, eleven were seen, moving conformably to the direction from Leo.

After 4 A.M., though the sky was favourable, no meteors were seen.

TABLE showing Number of Shooting-stars observed at Toronto between Midnight, November 13, and 6 A.M., November 14, 1867.

Time of Observation.	Number.	Mean Cloudiness during interval.	Total Number during Hour.	Mean Cloudiness during interval.
From Midnight to 1 A.M.	.....	.....	20	0·9
h m h m				
From 1 0 to 1 10	0	0·7		
„ 1 10 „ 1 20	6	0·7		
„ 1 20 „ 1 30	4	0·6		
„ 1 30 „ 1 40	10	0·2		
„ 1 40 „ 1 50	6	0·1		
„ 1 50 „ 2 0	18	0·0		
„ 1 A.M. to 2 A.M.	.....	.....	44	0·4
„ 2 0 „ 2 10	18	0·0		
„ 2 10 „ 2 20	21	0·0		
„ 2 20 „ 2 30	24	0·0		
„ 2 30 „ 2 40	16	0·0		
„ 2 40 „ 2 50	23	0·0		
„ 2 50 „ 3 0	21	0·0		
„ 2 A.M. to 3 A.M.	.....	.....	123	0·0
„ 3 0 „ 3 10	39	0·0		
„ 3 10 „ 3 20	46	0·0		
„ 3 20 „ 3 30	61	0·0		
„ 3 30 „ 3 40	108	0·0		
„ 3 40 „ 3 50	126	0·1		
„ 3 50 „ 4 0	180	0·2		
„ 3 A.M. to 4 A.M.	.....	.....	560	0·1
„ 4 0 „ 4 10	354	0·2		
„ 4 10 „ 4 20	430	0·2		
„ 4 20 „ 4 30	237	0·2		
„ 4 30 „ 4 40	145	0·2		
„ 4 40 „ 4 50	96	0·3		
„ 4 50 „ 5 0	83	0·3		
„ 4 A.M. to 5 A.M.	.....	.....	1345	0·2
„ 5 0 „ 5 10	65	0·4		
„ 5 10 „ 5 20	48	0·4		
„ 5 20 „ 5 30	42	0·5		
„ 5 30 „ 5 40	19	0·6		
„ 5 40 „ 5 50	13	0·7		
„ 5 50 „ 6 0	8	0·6		
„ 5 A.M. to 6 A.M.	.....	.....	195	0·5
Total number	.....	.....	2287	

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New York ('New York Herald').

After waiting and watching patiently throughout the night without observing anything more than an occasional meteor darting across the sky, such as can be seen on any clear night during this period of the year, the impression prevailed that the anxiously expected spectacle would not come off. At about 1 o'clock A.M. heavy snow-clouds commenced gathering on the east, west, and south, and gradually spread until they covered the greater part of the sky, forming a crescent over the north, but leaving that point very clear and blue, and covered with myriads of stars. Such was the situation of affairs at 1 o'clock.

Excepting, as before remarked, an occasional and fitful flash of light across the horizon, the meteoric display did not really commence before 3½ o'clock in the morning. At precisely that hour a meteor of a greenish-blue colour, and about the size of a star of the first magnitude, shot out from the direction of the constellation Leo, lighting up the sky with a long train of crimson fire, and travelling in a north-westerly direction. It had scarcely faded from the sight when another and equally brilliant, though not quite so large, came speeding across in its track, and it was followed by fourteen of smaller magnitude, one by one, in quick succession. At this moment a heavy cloud drifted towards the north, and for some minutes the spectacle was partially lost to view. That the meteors were falling rapidly, however, was plainly evident. From all points where the clouds were thin, occasional ones flashed out, and the frequent lighting up of the clouds, as they passed over, made it apparent that they were falling rapidly. At 10 minutes before 4 o'clock the northern sky again became clear; a thick and almost impenetrable cloud passed over the moon, partially obscuring its light, and thus enabling the watchers to view with greater distinctness the size and brilliancy of the meteors. The display was now a most magnificent one. The meteors shot out from Leo in all directions, and with remarkable swiftness travelled across the horizon. Sixty-three were counted in 1 minute and 10 seconds, of which three were of extraordinary size and beauty. One of these, of a greenish hue and followed by a long train of the same colour, travelled in the direction of Ursa Major, and as it was disappearing in the northern horizon apparently burst, lighting up the sky for a great distance on all sides. It was now

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utterly impossible to keep a correct account of the number falling. Eight, ten, and twelve sped onwards on their erratic course at the same moment; scarcely disappearing before others of equal splendour took their places. For fully twenty minutes they continued to fall with the same rapidity, during which time, exclusive of those already mentioned, 318 were counted. This number, however, was not one-fifth of that which really fell. Not less, perhaps, than from 1500 to 2000 radiated from Leo during this space of time, so that it was utterly impossible for one person to keep anything like an accurate account. At 10 minutes past 4 o'clock they appeared in smaller numbers, and gradually decreased until they averaged not more than three or four each minute. At 22 minutes past 4 o'clock the largest and undoubtedly the most brilliant meteor that has been seen for many years came rushing across the sky. It radiated from Leo, and took a direct northerly course toward Ursa Major, followed by a long train of yellowish-red hue, which spanned the horizon from its point of appearance to that of its disappearance. This meteor was of the same greenish-blue colour as the others which preceded it, and as it passed over about one-half of the course traversed, it seemed to burst, and then the spectacle was really beautiful. Apparently hundreds of fragments of almost blood-red colour broke from it and scattered in every direction, while it continued its course towards the north, no longer wearing its greenish-blue colour, but of one uniform and beautiful blue. The panorama it presented was exceedingly grand, and must have lasted at least three minutes before the varied colours disappeared, and the fire-lit skies resumed their wonted serenity. Meteor after meteor now followed in rapid succession until about 20 minutes before 5 o'clock, when they ceased to appear, except at intervals of ten or twelve seconds each. Even this number gradually decreased until 5 o'clock, when two large and brilliant ones, with long trains, shot out together, and were lost at almost the same moment in the northern horizon. Numerous small meteors came afterwards; but the grandeur of the spectacle had passed away.

The grey mists of morning and the November fog were now covering the rivers and the city. It was therefore almost impossible to do more than occasionally perceive the flashes of light which evidently came from those of great brilliancy; and as the morning advanced, even these became less and less distinct until they were finally lost to view, and the meteors in all their

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grandeur remained only in the memories of those who had witnessed them.

The following is the schedule of observations as taken by Professor H. P. Smith at the Observatory in the old arsenal building on Wednesday night and Thursday morning :—

Early in the night and up to 3 o'clock no more were to be seen than are visible any winter night. After 3 o'clock, however, they became frequent, and between 4 and 5 o'clock over two hundred were seen.

The first meteor was observed at $7^h\ 35^m$ in the evening, and the last at $5^h\ 38^m$ in the morning.

From	7 P.M.	to	8 P.M.	of November 13	1
„	8 „	„	9 „	.....	0
„	9 „	„	10 „	.....	1
„	10 „	„	11 „	.....	0
„	11 „	„	midnight	.....	2
„	midnight	to	1 A.M.	of November 14	0
„	1 A.M.	to	2 A.M.	.....	0
„	2 „	„	3 „	.....	6
„	3 „	„	4 „	.....	67
„	4 „	„	5 „	.....	224
„	5 „	„	6 „	.....	33
	Total number observed.....				334

Of the above, fifty-four left luminous trains behind them. With the exception of perhaps twenty, all took a northerly course. Owing to the greater number appearing in rapid succession, full particulars of only a few were obtained.

Commodore SANDS, Washington.

The display of meteors was the most brilliant seen in this country since the great shower of 1833.

In accordance with a request of Professor H. A. Newton, observations in the northern heavens for parallax were made between the hours of 11 P.M. and 2 o'clock A.M. Very few, however, were seen till 1 o'clock.

These observations were made, and the tracks of the meteors were drawn upon the map, by Messrs. Main, Lindenhahl, Lumbrock, and Filman, a party of assistants of the United States

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Coast Survey, who kindly volunteered their services. Forty-six meteor tracks were mapped down by them. Observations in conjunction with Professor Harkness, of this Observatory, at Richmond, Va., for parallax, were commenced after 3 o'clock by the Observatory party, Messrs. Newcomb, Eastman, Harrison, Doolittle, and Gardner. Arrangements had been made by the courtesy of the American telegraph to exchange telegraphic signals with Professor Harkness on the appearance of each meteor; but through some disarrangement of the wires communication could not be established.

One hundred and twenty-five meteor tracks were mapped before $4\frac{1}{2}$ o'clock, when the meteors flew so thick that identification of those seen from our two stations became hopeless, and simple counting was resorted to. 1000 meteors were counted in twenty-one minutes.

Afterwards successive hundreds were counted in the following intervals:—4^m, $5^m\ 30^s$, $5^m\ 35^s$, $5^m\ 44^s$, $9^m\ 3^s$, $9^m\ 37^s$, $10^m\ 31^s$, and $18^m\ 20^s$.

The first thousand being partly counted while mapping was still going on, it is probable that one-half were not seen; so that it may be estimated that 2000 really fell in the course of twenty-one minutes. The time of maximum thickness of the shower was about $4^h\ 25^m$. This is two hours later than that given by the European observations of last year, showing a slight change in the position of the stream.

Many of the meteors were remarkable for their brilliancy, and for having a brilliant greenish train, which usually vanished in a few seconds, but in one or two cases lasted several minutes. The radiant-point was very well defined, being in right ascension $10^h\ 1^m$, declination 22° 31′.

Next year the shower, if there be any, will not begin until 10 o'clock A.M., Washington time, and will therefore be seen only in the Pacific Ocean.

Richmond, Virginia.

Professor Harkness, of the United States Navy, reached Richmond yesterday for the purpose of taking an observation of the altitude of the meteors which were expected to appear as shooting-stars last night. Having obtained a suitable position, he saw this morning, about 3 o'clock, quite a shower of meteors at about the

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altitude of 100 miles above the surface of the earth. In regard to these showers he says :—

The most singular part of the whole matter is, that within the last few months it has been proved, almost beyond the possibility of a doubt, that several small comets which have been recently observed, actually move in and form a part of this stream. In other words, these comets are neither more nor less than rather large meteors. All day on Wednesday both the meteors and the earth were rushing in a headlong chase to a point of space ; and about 3 o'clock on Thursday morning the earth plunged into the stream. Instantly stars began to fall as thick as autumn leaves. Scarcely an instant passed that their fiery trails were not to be seen lighting up the silent sky ; and for much of the time there were half a score in the air at once. Some were mere specks of light—faint sparks from the laboratory of nature—while others shone with a brilliancy surpassing that of the largest rockets and with all the colours of the rainbow. At 4¼ o'clock the earth had reached the thickest of the stream, and the colossal bombardment was at its height. Two observers, whose range of vision only embraced about half of the visible heavens, counted 193 meteors in ten minutes. They were flying past the earth at the rate of more than 2000 every hour, and as each one passed, the friction caused by its flight through the atmosphere was so great that it burst into flame, lighting up the heavens, and for a brief instant contributing its mite to the brilliant spectacle, then plunging again into the depths of space, no more to be seen by mortal eye till the expiration of another period of thirty years.

In regard to the main body of the stream Professor Harkness says :—

It was thicker, and the meteorites more numerous in some places than in others. In one particular region they were more thickly crowded together than in any other, and regularly once in about thirty-three years it returns to the point in space traversed by the path of the earth in November, and gives rise to the famous star-showers, about which so much has been said and written of late. No one can expect to witness a spectacle of such a character more than once in a lifetime ; and the brilliancy and sublimity of that of last night was such as to stamp itself indelibly upon the memories of those who were so fortunate as to behold it.

Professor Harkness has made no official report to Commodore Sands, and will not do so until his return to Washington.

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ALBANY.

1h A.M. A few minutes after this hour ten meteors of a light reddish hue, eight of them of the brightness of a star of the second magnitude, were seen, having their flight through the constellations Gemini and Canis Major, emanating from the direction of the constellation Leo. This gave courage to combat the chilling atmosphere and hope of the shower's initiation. To interpose seriously and mar the effect of the display, clouds came thickly up from the north-west, obscuring a portion of the eastern sky. At 1h 25m two of great brilliancy, double the size of the star Sirius, shot from the clouds from the position of Leo, one toward the south, the other toward the north-west, producing phosphorescent lines along their course, and before their disappearance emitting luminous trains.

3h A.M. Until this hour the sky was overcast, obscuring the point of the meteoric emanations, and it had a depressing effect upon the observers, who had not seen enough that was tangible to keep their spirits up. Time passed quickly, until it was noted with pleasure that the clouds had broken and the firmament was again in view, with Leo trooping in majesty far up the zenith.

3h 50m A.M. Now the splendour commenced. First, a pale reddish meteor shot from Leo, and proceeded southward. This heralded the brilliant show. In fifteen minutes, thirty-seven, six with trains of lurid brilliancy, had been seen. Professor Hough and his assistant, Thomas E. McClure, were on active duty; and four assistants stationed at different points, chronicled the flight of each meteor.

4h 16m A.M. They came in larger numbers and extremely more luminous than the others. Four, bright as a star of the second magnitude, shot in quick succession to the north-west horizon. They are radiating from Leo in all directions.

4h 18m A.M. The brightest yet, with a beautiful purple and amber colour, shot toward the south-west under the moon, its trail of flame being visible for fifty seconds, and then fading away in brilliant nebulæ.

4h 25m A.M. 180 had been chronicled; at 4h 30m, 312; at 4h 33m, 440, being nearly forty-three per minute. At this time the eastern sky was almost entirely clouded over. At 4h 35m, 512 had been seen; at 4h 38m, 610; at 4h 41m, 708; and shortly after the sky became clear. At 4h 48m, 900 were chronicled; and one larger and brighter than any that preceded it, started from Leo, speeding

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to the eastern horizon; it was of oriental sapphire colour, and its flight was like the flash of sheet lightning. At $4^h\ 53^m$, 1000 had been seen; at $4^h\ 59^m$, 1100.

$5^h\ 1^m$ A.M. This time two of dazzling brilliancy shot simultaneously from the same point of emanation, traversing the heavens in a parallel manner through Ursa Major, disappearing in the northern horizon. They were of deep purple, and had long, beautiful trains, that rested upon the sky in their full contour nearly a minute.

$5^h\ 7^m$ A.M. Still another of magnificence from Leo, in the direction of north-east to horizon; it was of twice the brightness of Sirius, and shot in its luminous path by the star Arcturus, leaving a trail, startling in its amber hue, for sixty-five seconds in duration.

$5^h\ 8^m$ A.M. 1200! It is cloudy in the zenith, clear in the east. Jupiter and her satellites have long since set, the moon still shines with splendour, affecting the spectral lustre of the stars; while Leo is trooping up higher and higher in the zenith. Many meteors are now passing through Ursa Major in their erratic flights. A broad belt of blue sky, strangely beautiful, extends from Leo to the horizon.

$5^h\ 17^m$ A.M. Another large meteor, brighter than Sirius, disappearing in the eastern horizon with a trail very brilliant, and of green and orange, was observed.

$5^h\ 20^m$ A.M. The scene has again shifted. The clouds, like solid columns, have trooped back again and covered the sky.

$5^h\ 22^m$ A.M. 1247, sky clearing.

$5^h\ 38^m$ A.M. Daylight appearing, sky perfectly clear.

At $5^h\ 41^m$ A.M. One magnificently luminous from Leo shot north 15°, leaving its broad amber and purple train sixty-seven seconds after appearance. The blue sky now turned more softly grey, the stars began to disappear and the east to kindle. Faint streaks of purple soon appeared along the sky, and the whole was shortly filled with the tides of morning light, and as the gates of morning were about opening, still other bright meteors shot across the sky, bright, brilliant in colours, and before the sun began his course, 1301 had been chronicled, fifty of greater brightness than stars of the second magnitude.

TROY.

The meteoric display was a little tardy in our heavens; but the celestial visitants "put in an appearance" at 4 o'clock this

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morning. The star-shower not occurring at or about 2½ A.M., as anticpated, the vast majority of meteor-gazers had retired, and your correspondent and the police on duty were about the only ones in this vicinity who were vouchsafed a satisfactory look at the strangers in the heavens.

At 4 o'clock there was a sudden and very perceptible lighting up of the sky, as several partially brilliant semi- or small comets shot with great force across the heavens, apparently at right angles with each other, and evidently without any visible order or system. The night was unusually clear, and the condition of all things was favourable for a fine display. The professional observers at the Rensselaer Polytechnic Institute, situated here, are understood to have noted the flight across the sky of six distinct meteors. At 4^h 35^m A.M. the most brilliant of those blazing stars appeared in full view, and presented a magnificent sight indeed. It seemed to pass up from the south, and took from here a north-easterly direction. It is believed that this fine meteor was far brighter and more intensely luminous than any one of the remarkable similar phenomena of last year.

POUGHKEEPSIE.

There was a magnificent display of meteors at this place between 4 and 5 o'clock this morning. A close observer counted 630 during the time mentioned. Nearly all passed through or within the vicinity of the Great Bear. Just before 4 o'clock a brilliant one with a long tail, some 20° in length, shot across the heavens from east to west. It was of a violet colour, and when it reached a point 15° above the horizon it burst like a sky-rocket, several streams of light branching off from it. From personal descriptions there must have been 1000 meteors visible within the line mentioned.

EVANSTON, ILLINOIS.

The observers at Heck Hall, Evanston, Illinois, report, notwithstanding the sky being partially obscured by clouds and full moon, there was a fine display of meteors this morning. The maximum occurred between 3 and 4 o'clock, when 1109 were counted between 3^h 20^m and 4^h 12^m A M. at Dearborn University, and a still larger number were seen.

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Detroit, Michigan.

Professor Watson, of the Michigan University, reports that, notwithstanding the light of a full moon and the smoky state of the atmosphere, a fine display of meteors was observed here this morning. The maximum occurred at 4 o'clock, at which time they were counted at the rate of 1500 per hour. The number actually visible was very much greater; and glimpses were had of large numbers whose light feebly prevailed over that of the full moon. The radiant-point was found to be situated in right ascension 159° and declination 22° north.

Scranton, Pennsylvania.

The meteoric shower this morning was very brilliant. As late as 5 o'clock no less than sixty were counted in the space of ten minutes. The sky was cloudless and the moon shone brilliantly.

Wilmington, Delaware.

The display of meteors from 2 to 4½ this morning was very fine. Notwithstanding the bright moonlight, an observer counted 500 in twenty minutes, after 4 o'clock, and thinks there were between 2000 and 3000.

Professor Loomis, New Haven, Connecticut.

The expected display of shooting-stars occurred this morning and attained its greatest magnificence about 4½ o'clock. I counted 500 meteors alone in one hour, which would indicate about 3000 per hour for the entire heavens, and that, too, in the presence of a full moon, which probably eclipsed two-thirds of the whole number. So far as the numbers are concerned, this exhibition was, therefore, more remarkable than that seen in Europe last November, and was but little inferior to that seen in the United States in 1833.

Charleston, South Carolina.

The meteoric display this morning was very brilliant, lasting several hours.

New Orleans.

The meteors appeared here this morning, unexpected by everybody, as no interest was taken in them. They first made their appearance at 3 A.M., passing from a north-easterly direction across the heavens, and disappearing near the horizon. For the first

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few minutes very few were seen, but they increased in number until nearly 4 o'clock, when they were numerous, and the shower was very brilliant. The meteors of the larger size and brilliancy were from the north-east; but smaller ones appeared elsewhere, and took different directions. The meteors resembled balls of fire rolling over the heavens, leaving a fiery trail behind them. About 4 A.M. the shower terminated. The weather was cold and clear.

Commander W. CHIMMO, F.R.A.S., F.M.S., off Martinique, West Indies.

Rounding the north point of Martinique at 5^h in the morning of the 14th of November, while sitting on the bridge, I saw an immense number of bright sparks falling into the sea, at apparently a short distance from the ship's funnel, as they resembled those of sparks caused by the burning of wood.

I took no further notice until my attention was arrested by a brilliant meteor bursting in the east and emitting sparks like those of a rocket, shooting in a north direction at an altitude of about 37° and at an angle of 75° with the horizon.

I then called the attention of the First Lieutenant and Master, who were on the bridge at the time, to the meteoric shower then in view, falling rapidly and perpendicularly, every now and then a brilliant meteor bursting and lighting up the whole heavens. It was in reality a grand sight of fireworks.

The spot of blue sky from which they fell was about one-sixteenth of the whole heavens, and from the edge of a dark cloud of nimbus which was hanging over the island.

I merely send this as a simple notice for record that the shower was seen at this place; but on board a ship, in the anxiety and excitement of going into a strange harbour, was not the time nor place to make any detailed observations.

TRINIDAD.

The meteoric shower was distinctly seen at this place, on the morning of the 14th of November between 2 A.M. and daylight, when 1600 were counted, and about 8 per cent. thought to have been missed. The meteors seen were numerous in the N.E., describing arcs of 60°. Some were of a reddish hue, others green, and one of a bright fiery-purple, lasting many seconds. From midnight till $5^h\ 30^m$ A.M. 693 meteors were counted; 23 per cent. were of the brightest description.

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G. W. H. Maclear, Esq., Cape of Good Hope.

November 12, between the hours of 8 P.M. and midnight, Cape mean time, three meteors were seen.

November 13, between the hours of $10^h\ 45^m$ and daylight, nine meteors were seen.

November 14, no meteors were seen till $1^h\ 52^m$ on the morning of the 15th, and seventeen meteors were seen, principally from Leo, by $3^h\ 35^m$.

VII. *On Changes of Mean Temperature in Long Periods.* By Herr Lucas. Translated by W. T. Lynn, Esq., B.A., F.R.A.S.

Some remarks made by Herr Lucas, of Arnstadt, in Thuringia, on the question of changes of temperature in long intervals of time, and printed in a late number of the 'Zeitschrift' of the Austrian MeteorologicalSociety, appear to me of sufficient interest to lead me to offer the following translation of them to our own older Society.

Glaisher, the well-known aëronaut and meteorologist, states that he has discovered, from observations of the thermometer at Greenwich, extending over 100 years, that the mean temperature of England has increased by 0°·9 Reaumur. He asserts that, especially in the winter months, the increase in the mean temperature is very considerable, and is particularly marked in January, the mean temperature of that month being now 1°·33 R. higher than formerly. Glaisher then raises the question whether a similar increase in mean temperature of the year or of single months has made itself observable also in other countries.

As regards Germany, Dove has proved that the mean temperature has not changed in an interval already embracing more than a hundred years; whilst, in Poggendorff's 'Annals,' attention was called more than ten years ago to the fact that in this century, from thermometric-observations in several places in Germany, in Vienna, Regensburg, Prague, Hamburg, &c., a decrease rather than an increase of mean temperature has made itself perceptible.

If it is permissible to draw conclusions concerning change of mean temperature from forty years' thermometer-observations, it will result that here also in Arnstadt no increase, but actually a trifling decrease, has taken place, which, however, would easily be

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made to disappear in the course of the next decade by a few warm years following each other closely. On the other hand, Glaisher's remark that the mean temperature of the month of January is now considerably higher than formerly is perfectly correct also for Arnstadt. Glaisher has not remarked any particularly striking increase of mean temperature at other seasons of the year, but rather a diminution. On the other hand, here, in Arnstadt, the month of December shows quite as great and even a greater decrease of mean temperature than the increase in January; but the three winter months together, December, January, and February, give a mean winter temperature which has continued precisely the same in the last forty years. There is room, therefore, for the conjecture that only an oscillation or different distribution of the winter cold has taken place, without any change of the winter mean temperature. The summer, like the winter, has preserved its mean temperature; whilst the spring and autumn have become colder, excepting the months of April and of October, which have undergone only an insignificant alteration.

The following Table shows the numerical values of the separate mean temperatures:—

	Mean Temperature.							
	Dec.	Jan.	Feb.	Winter.	Mar.	April.	May.	Spring.
From 20 years, 1823–42	°0·70	°−2·68	°−0·65	°−0·88	°2·57	°6·18	°10·38	°6·38
From 40 years, 1823–62	0·02	−2·15	−0·45	−0·86	2·26	6·15	10·05	6·15
Difference.....	−0·68	+0·53	+0·20	+0·02	−0·31	−0·03	−0·33	−0·23

	Mean Temperature.								
	June.	July.	Aug.	Summer.	Sept.	Oct.	Nov.	Autumn.	Whole Year.
From 20 years, 1823–42 ...	°12·90	°14·20	°13·70	°13·60	°11·05	°7·15	°2·75	°6·98	°6·57
From 40 years, 1823–62 ...	12·91	14·14	13·60	13·76	10·77	7·24	2·41	6·81	6·42
Difference.....	+0·01	−0·06	+0·06	0·00	−0·28	+0·09	−0·34	−0·17	−0·15

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Dr. Jelinek, the editor of the 'Zeitschrift,' remarks upon this paper that the investigations in Germany, which Lucas refers to, were made by Fritsch, who determined, by means of observations at twenty stations, extending over at least fifty years, that the majority indicated a maximum of annual temperature about the year 1800, and a continuous decrease after that time. But as Lucas has raised again the question of changes of temperature in the separate months, he has been induced to put together in groups of ten years the mean temperatures for each month during the last ninety years, for which observations, made at Vienna, are available. The result on the whole gives a gradual decrease of the mean temperature for every month, with the single exception of October.

Jelinek concludes that he is well aware that results of this kind must be received with a certain amount of caution, and that the question of secular changes of temperature cannot be decided until after a longer interval of time; but the numbers he has obtained, as there was nothing arbitrary in the grouping, must at least lay claim to some degree of interest.

VIII. *On an Aerolite seen at the Cape.*

By G. W. Bennett, Esq., Fort Beaufort.

On the 1st of June, 1867, a very large aerolite burst somewhere about here; the report was so loud that it was heard at Graham's Town here, King William's Town, Whitlesea, Bloemferiten; and several people saw the explosion high up in the air; to residents here it appeared as if the fragments fell about fifteen miles away; and the inhabitants of Bloemferiten "made the same estimate of distance from their town." These places are a long distance asunder: the report was like that of very loud thunder; the sky was cloudless at the time, 1 P.M.; the flash was very vivid; those who witnessed the explosion said that a white smoke arose at the spot, which was some time in dissipating. It is a pity none of the fragments have been found. If you have a map of the Cape handy, just mark the relative situation of the places I have named, and you can fairly estimate what a tremendous report it was; about twelve miles from this, the houses fairly shook, and the people thought a powder-magazine had exploded.

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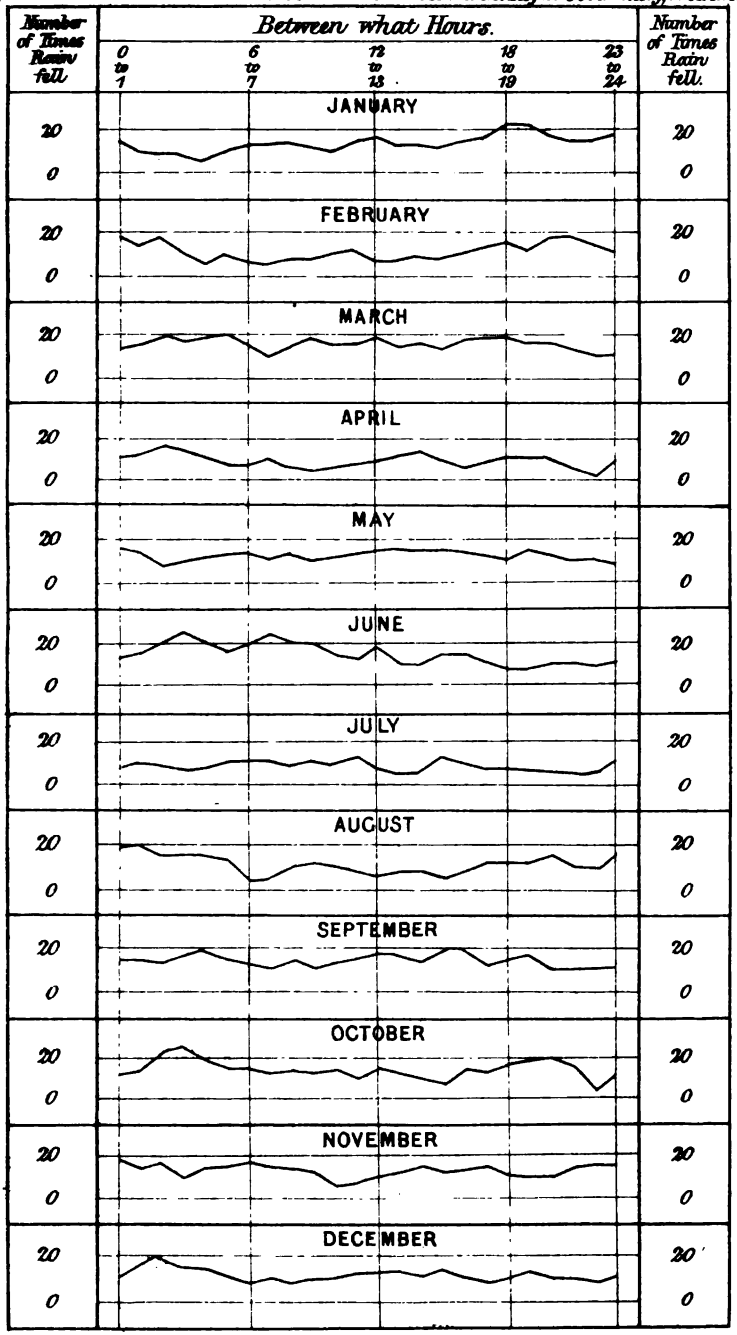
Diagram shewing the number of times rain fell in every hour in every month, in the years 1861 to 1866, as found from the observations taken at the Royal Observatory, Greenwich.



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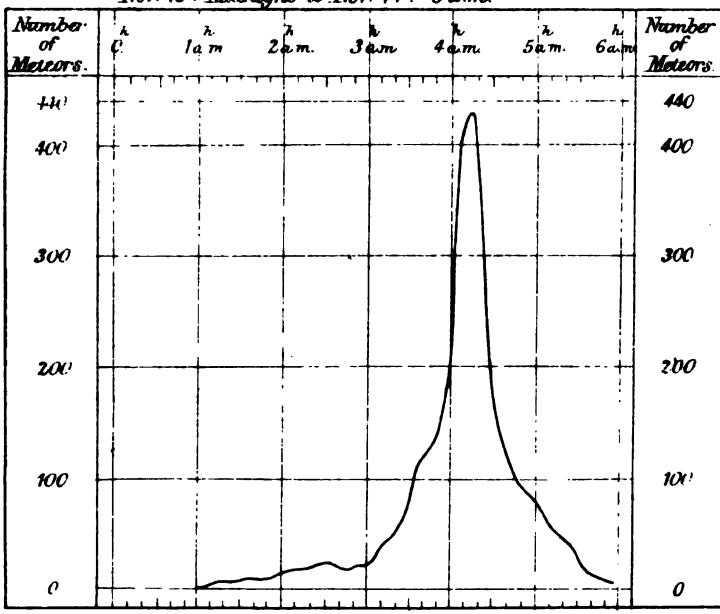
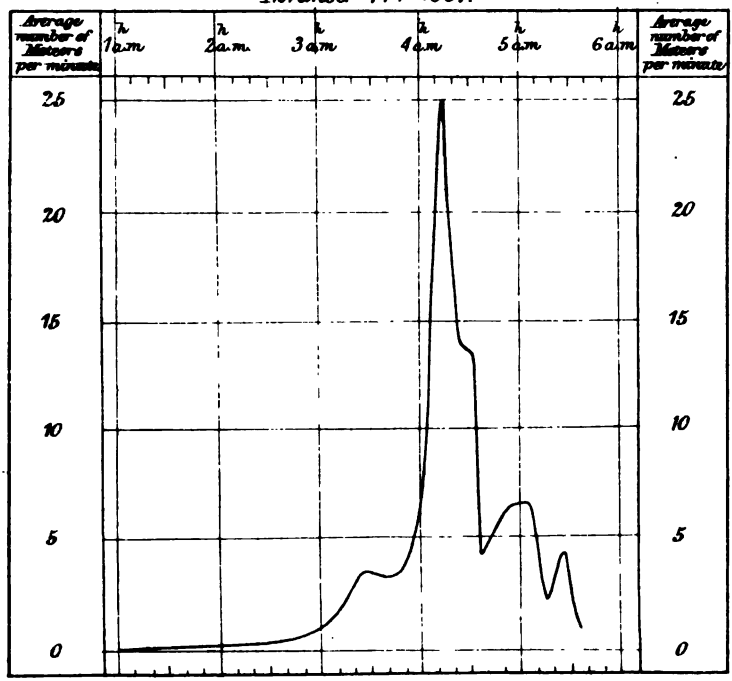
Toronto. *Number of Meteors at intervals of 10 Minutes from (1867) Nov.r 13th Midnight to Nov.r 14th 6 a.m.*



Nassau. N.P. Bahamas. *Curve of average number of Meteors per minute November 14th 1867.*



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SESSION 1867–68,

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JAMES GLAISHER, Esq., F.R.S., President.

1868, FEBRUARY 19.

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JAMES GLAISHER, Esq., F.R.S., President.

Vol. IV. 1868, FEBRUARY 19. [No. 35.

JAMES GLAISHER, Esq., F.R.S., &c., President, in the Chair.

A. Morton Festing, Esq., Deputy Assistant Commissary General to H.M. Forces, Commissariat Department, Kilkenny;
Murray Thompson, Esq., M.D., F.R.S.E., Reporter on Meteorology to Government of N.W. Provinces of India;
were balloted for and duly elected Fellows of the Society.

IX. *On some of the Laws which appear to regulate the Temperature of Months and Seasons.* By G. D. Brumham, Esq.

The investigations that I have made during the last few years with regard to predictive meteorology lead me to the conclusion that the development of this branch of meteorological science mainly depends on the due application of principles of uniformity and regularity. In connexion with mean temperature these principles are strikingly developed. Persistent steadiness, and frequently repeated uniformity of monthly mean temperatures, precede extremes of cold or heat according to the season of the year. In summer they precede a severe winter, and in winter

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they are the precursors of great summer heat. It is probable that extremes of temperature happen after the frequent occurrence of uniform means, because the latter phenomena necessarily accompany a prevalence of calm weather or uniform winds; for when there is a considerable intermingling of air-currents there must always be great variations of temperature; but when nearly the whole of the atmosphere north of the equator (and especially the air of the upper regions) has been frequently in a state of comparative repose, the heat accumulates to an unusual extent in the tropical atmosphere of this northern hemisphere, if the sun is approaching it, and the still air of the arctic latitudes becomes intensely cold, if the sun is receding from them; so that, after those conditions have prevailed, a tropical current will bring us extreme summer heat, and polar winds intense winter cold.

There are two rules given in the present paper which have no reference to uniformity. The first is connected with Table VI., and the second with Table XI. The other rules are all founded on that principle.

There are a great many rules and laws connected with thermometrical and rainfall observations which are also based on principles of uniformity; but the laws given in the present paper are limited to deductions from Mr. Glaisher's monthly mean temperatures of all the years from 1771 to 1849 inclusive as published in the 'Philosophical Transactions,' the subsequent years being taken from the Greenwich volumes.

Laws deduced from the Greenwich Monthly Mean Temperatures relative to the prediction of Summer Seasons.

When the means of the first three months of the year have been so nearly uniform that the range of monthly mean temperature in the first quarter of the year has been only 1°·2 or less, the succeeding summer has *invariably* been characterized by such extraordinary heat as to lead to the conclusion that the coincidence must be the result of an infallible law. Table I. contains *all* the instances in the last ninety-seven years when this uniformity has occurred.

When the range of monthly means in the first quarter of the year is above 1°·2, but not more than 1°·5, the succeeding summer is always very hot; but if the season is *remarkably* dry, the days will be extremely hot, and the nights sufficiently cold to reduce the mean temperature of some of the summer months below the average. The only instances in the last ninety-seven years when

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the means of the first quarter have been between 1°·2 and 1°·5 are given in Table II.

TABLE I.

References to the Notes.	Year.	Range of Means in the first quarter.	Mean Temperature of			Difference from average of		Maximum Temperature near London or in Suffolk.
			Jan.	Feb.	Mar.	May to Sept.	April to Sept.	
(1.)	1865.	0°·3	36°·3	36°·6	36°·6	+3°·0	+3°·5	89° at Chiswick, and 91° at Stockwell; at Greenwich it was 81½° in April, 86° in Sept., and on twenty-one days from 80° to 87°.
(2.)	1825.	0·4	38·4	38·1	38·5	+2·1	+2·1	97° at Tottenham; 95° on two days, 91° or 92° on five days, and on thirty-two days from 80° to 89°, at the same place.
(3.)	1846.	0·6	43·7	43·9	43·3	+3·7	+3·2	95° at Chiswick; at Greenwich it was from 90° to 93° on five days, three times within a fraction of 90°, and twenty-four times from 80° to 88°.
(4.)	1808.	0·8	37·0	36·3	37·1	+1·9	+0·9	99° in Suffolk; at Plaistow it was 96° on one day, 94° on one day, 92° on one day, and from 80° to 88° on fifteen days.
(5.)	1806.	0·9	40·6	41·5	40·7	+1·1	+0·3	95° at Plaistow on one day, 93° on one day, 90° on one day, and from 80° to 87° on seventeen days at the same place.
(6.)	1852.	1·2	42·0	40·8	41·3	+0·8	+0·6	97° at Chiswick, and at Greenwich from 80° to 89° on twenty days.

(1.) Mr. Glaisher says, "The summer of 1865 (reckoning from April to September) was the warmest ever known." In this year we had the hottest April and the hottest September on record.

(2.) Luke Howard speaks of "the superb weather and Italian skies of 1825." "July had precisely the mean temperature of the Mediterranean."

(3.) Mr. Whistlecraft speaks of this summer as "the notably hot summer." The mean of the whole of that hot season was only a little below that of 1865.

(4.) The mean of the whole summer was not quite 1° above the average.

(5.) Luke Howard speaks of "the warm temperature of 1806." The mean of the whole summer was not 1° above the average.

(6.) The mean temperature of the whole summer did not reach 1° above the average.

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Table II.

References to the Notes.	Year.	Range of Means in the first quarter.	Mean Temperature of			Difference from average of		Maximum Temperature near London or in Suffolk.
			Jan.	Feb.	Mar.	May to Sept.	April to Sept.	
		°	°	°	°	°	°	
(1.)	1788.	1·3	37·4	38·7	38·6	+0·4	+0·9	85° in Suffolk in June, July, and August.
(2.)	1840.	1·4	39·0	38·1	37·6	−0·5	+0·1	86° in Suffolk in August, and from 80° to 85½° on fourteen days at the same place.
(3.)	1775.	1·5	40·4	41·9	41·7	+1·8	+2·2	85° in Suffolk in April.

(1.) Mr. Glaisher says, "The summer of 1788 was in general dry, and there were several periods of *hot* weather in April, May, and June." *It was a year of great drought.*

(2.) Mr. Whistlecraft says, "in 1840 the season was *unusually warm*, and earlier than I ever before noted; the heat was very great from July 14 to September 22, with very little intermission." *It was a year of great drought.*

(3.) Mr. Glaisher says, "The summer of 1775 was dry and hot;" and Mr. Whistlecraft says, "the thermometer in April rose to 85°."

I will now record some very important facts, which, coupled with the foregoing tabulated statements, appear to demonstrate the truth of the law I have given:—

1. The nearest approach to absolute uniformity in the winter quarter's monthly means was in 1865; and, according to Mr. Glaisher, the six months' summer of that year was *the hottest on record.* That year is also distinguished above all others for having *two* of the hottest summer months ever known; it had the hottest April and the hottest September on record. In the latter month the maximum temperatures were most extraordinary.

2. Not only have *all* the summers that were preceded by uniform monthly means in the first quarter of the year (by uniform I mean when the extreme range did not exceed 1°·2) been distinguished for extraordinary maximum temperatures, but there is *no year*, except 1858, for a century past, in which the maximum has reached 95° without this uniformity having prevailed.

3. When the monthly means of the first three months of the year have been nearly uniform, the succeeding summer has been extremely hot, whether the winter has been very cold or very mild. In such cases of uniformity, severe frost and unusual mildness, as

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well as a moderate temperature, exercise no influence over the character of the succeeding summer; for, in the six years mentioned in Table I., the winter quarter was twice very mild, twice a medium, and twice very cold.

4. Between 1770 and 1806 there were very few years in which the monthly means of the winter quarter were anything like uniform; and in that thirty-five-year period high summer maximum temperatures and high monthly means were much less common than they have been since. These statements harmonize with Mr. Glaisher's researches; for that gentleman has discovered that "every month of the year seems to be somewhat warmer than before" this century commenced.

5. In Table II. it will be seen that the means of the summer periods (of six months) are almost exactly inversely proportionate to the extreme range of the monthly mean temperatures that occurred in the preceding first quarter of the year; for instance, the first three months of 1865 show the narrowest range in this respect that has occurred in the last ninety-seven years (only ·3 of a degree), and the succeeding summer was, as we have seen, the hottest on record. In 1825 and 1846, when the range was nearly as narrow, the summers were altogether extremely hot; indeed the mean of each of these three summers was *more than* 2° above the average, those of 1865 and 1846 being more than 3° above the average; but in 1806, 1808, and 1852, when the range in the means of the winter months was considerably wider, the heat of the succeeding summers was proportionately less, the mean temperature of the summer of each of these three years being *less than* 1° above the average.

If we take into consideration the relative maximum as well as mean temperatures in the above-mentioned years, we may fairly dispose the group of unusually hot summers in the order in which I have placed them in Table II., which, it will be seen, is according to the order of the range of monthly means in the preceding first quarter of the year. The foregoing facts appear to be sufficient proofs of the law I have given; and, although there are other causes of great summer heat, a uniform mean temperature in the first quarter of the year is evidently one infallible cause or sign of approaching high summer temperature both as regards maxima and means.

When the mean temperatures of *all* the months, from November to March inclusive, are *above* the average, the succeeding summer

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is *always* above the average also. The following are all the instances of this kind in the last ninety-seven years:—

TABLE III.

References to the Notes.	Years when the Means from November to March were above the average.	Years of Summer.	Difference from the average of			Maximum Temperature near London.
			June, July, & August.	May to Sept.	April to Sept.	
			°	°	°	°
(1.)	1821–22.	1822.	+2·0	+1·8	+1·6	92 at Tottenham.
(2.)	1833–34.	1834.	+2·4	+2·7	+2·0	94 at Chiswick.
(3.)	1834–35.	1835.	+2·5	+1·7	+1·4	92 „ „
(4.)	1845–46.	1846.	+4·2	+3·7	+3·2	95 „ „
(5.)	1848–49.	1849.	+0·9	+1·2	+0·6	89 „ „
(6.)	1850–51.	1851.	+0·3	−0·1	−0·3	91 „ „

(1.) "Great heat in May, June, and August."
(2.) "Extremely hot all the summer." (3.) "A very hot and dry summer."
(4.) "A notably hot summer." (5.) "A fine and warm summer."
(6.) "Excessive heat from June 19th."

When the means, from December to March inclusive, are above, or about the average, the succeeding summer is *almost* always above the average. The following are all the instances since 1791:—

TABLE IV.

References to the Notes.	Years when the Means from December to March were above the average.	Years of Summer.	Difference from the average of			Maximum Temperature near London or in Suffolk.
			June, July, & August.	May to Sept.	April to Sept.	
			°	°	°	°
	1805–06.	1806.	+0·7	+1·1	+0·3	95 at Plaistow.
	1818–19.	1819.	+0·3	+1·0	+1·1	86 at Tottenham.
	1827–28.	1828.	+0·2	+0·6	+0·6	89 at Chiswick.
(1.)	1851–52.	1852.	+1·5	+0·8	+0·6	97 „ „
(2.)	1856–57.	1857.	+3·9	+3·4	+2·7	92½ at Greenwich.
(3.)	1858–59.	1859.	+4·2	+2·8	+2·3	93 „ „
	1861–62.	1862.	−1·8	−0·2	+0·2	84 in Suffolk.
(4.)	1862–63.	1863.	+0·2	−0·5	0·0	88 at Chiswick.

(1.) "Intensely hot July." (2.) "A very hot season."
(3.) "An extremely hot summer." (4.) "A very fine summer."

When the means, from November to March inclusive, are all above the average (excepting January), the succeeding summer is always above the average also. The following are all the instances:—

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TABLE V.

References to the Notes.	Years when the Means from November to March (excepting January) were above the average.	Years of Summer.	Difference from the average of			Maximum Temperature near London or in Suffolk.
			June, July, & August.	May to Sept.	April to Sept.	
(1.)	1778–79.	1779.	+2°·3	+2°·5	+2°·9	94° in Suffolk.
	1793–94.	1794.	+0·6	−0·5	+0·1	87 in Suffolk.
(2.)	1841–42.	1842.	+2·7	+1·6	+1·3	93 at Chiswick.
	1847–48.	1848.	−0·6	+1·0	+1·0	88 „ „

(1.) "Very great heat all spring and summer."
(2.) "A very hot summer."

It is worthy of note, as a further proof of the efficacy of these laws, that, in the last ninety-seven years, the hottest of each of the six summer months occurred in one of the years given in the foregoing Tables. They are as follows:—

The hottest April on record was in 1865 (see Table I.), when the mean temperature was 52°·8.

The hottest May on record was in 1848 (see Table V.), when the mean temperature was 59°·7.

The hottest June on record was in 1846 (see Table I.), when the mean temperature was 65°·3.

The hottest July on record was in 1859 (see Table IV.), when the mean temperature was 68°·1.

The hottest August on record was in 1857 (see Table IV.), when the mean temperature was 65°·8.

The hottest September on record was in 1865 (see Table I.), when the mean temperature was 63°·9.

There is one other infallible rule for summers connected with the Greenwich monthly mean temperatures, it is as follows:—When the mean temperature of *June* is *below* that of *May*, or when the difference between the means of May and June is not more than seven- or eight-tenths of a degree, the remainder of the summer is always remarkable for very low temperature; and it is worthy of notice that this is the case whether April and May have been hot or the reverse. The following are all the instances in the last ninety-seven years relative to this rule:—

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TABLE VI.

Year.	Mean Temperature of May.	Mean Temperature of June.	Difference from the average of July, Aug., and Sept.	Remarks.
	°	°	°	
1771.	54·5	54·0	−2·9	Mr. Glaisher says, "the summer was cool and dry."
1784.	56·8	56·2	−1·8	Mr. Barker says, "the summer was in general cold and backward."
1823.	54·6	55·4	−1·4	Mr. Whistlecraft says, "the summer was cold."
1830.	54·7	55·3	−1·3	
1833.	59·4	59·8	−2·1	
1841.	56·8	56·4	−0·7	
1848.	59·7	58·5	−0·9	

When the difference between the means of May and June is bout 1° or 1½°, the remainder of the summer is generally very cold; such was the case in 1789, 1860, and 1862; but the summers of 1800 and 1808 were exceptions to this rule.

Laws deduced from the Greenwich Monthly Mean Temperatures relative to the prediction of Winter Seasons.

The same principles of uniformity and regularity that control summers appear also to govern winters.

When the monthly means of the summer quarter (July, August, and September) have been nearly uniform, that is, when the range has been not more than 1°·5, the mean temperature of the succeeding winter has *invariably* been below the average. The following are all the instances of that kind in the last ninety-seven years:—

TABLE VII.

Reference to the Notes.	Year.	Mean Temperature of			Range.	Mean Temperature of December, January, and February.	Difference from average of December, January, and February.	Minimum Temperature near London or in Suffolk.
		July.	Aug.	Sept.				
		°	°	°	°	°	°	
(1.)	1796.	58·6	59·9	59·1	1·3	33·8	−4·1	−6° at Clapham. −6°·5 at Tottenham.
	1804.	60·2	59·9	59·4	0·8	36·3	−1·6	
	1810.	60·9	60·5	59·4	1·5	37·2	−0·7	+14° " "
	1812.	57·4	57·0	55·9	1·5	37·0	−0·9	+18° " "

(1.) Mr. Glaisher says, "a severe frost set in in December 1796, and the thermometer, in many places, on the 24th, was below zero of Fahrenheit's scale." In some places it was −16°, which is, for this country, the greatest cold on record.

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When the monthly mean temperatures, from May to September inclusive, are uniformly *below the average*, the succeeding winter is almost invariably colder than usual. The following are all the instances in the last ninety-seven years that have reference to this rule:—

TABLE VIII.

Reference to the Notes.	Years when the Means from May to Sept. were below the average.	Difference from the average of December, January, and February, in the years		Difference from the average of Dec. to March, which is 38°·7.	Minimum Temperature near London or in Suffolk.
			°	°	
	1782.	1782–83.	−0·4	−1·4	
(1.)	1799.	1799–1800.	−3·2	−3·5	− 3° in Suffolk.
	1812.	1812–13.	−0·8	−0·2	+14° „ „
(2.)	1813.	1813–14.	−5·3	−5·6	+ 4° „ „
	1820.	1820–21.	0·0	+0·3	+17° „ „
(3.)	1837.	1837–38.	−3·5	−2·6	−14° at Claremont.
	1838.	1838–39.	+0·3	−0·2	+17° in Suffolk.

(1.) "A severe frost at Christmas."
(2.) "Great frost and snow till March 21st."
(3.) "Very severe frost and snow till February 24th."

When the monthly means from February to November of any year are several times nearly uniform for two months together, and when, in addition, the arithmetical progression of mean temperature has been frequently developed, and when (if I may be allowed the term) the arithmetical retrogression of mean temperature has been continuous or frequent,—in other words, when the monthly means and the differences between the monthly means have contributed to uniformity eight times or more (from February to November inclusive), the succeeding winter is severe, and usually very severe. The following are all the instances in the last ninety-seven years:—

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Table IX.

Reference to the Notes.	Year.	No. of Months that contributed to uniformity.	Years of Winter.	Difference from the average of Dec. to Feb., which is 37°·9.	Difference from the average of Dec. to Mar., which is 38°·7.	Minimum Temperature near London, in Suffolk, or in Hants.
				°	°	
(1.)	1783.	8	1783–84.	−6·0	−5·7	
(2.)	1784.	8	1784–85.	−5·5	−6·0	0° at Selborne.
(3.)	1794.	10	1794–95.	−6·4	−5·5	−6° at Clapham.
	1810.	8	1810–11.	−0·8	−0·1	14° at Stratford.
	1812.	9	1812–13.	−1·0	−0·3	18° at Plaistow.
(4.)	1813.	9	1813–14.	−5·5	−5·7	4° in Suffolk.
(5.)	1822.	8	1822–23.	−2·6	−0·3	4° at Tottenham.
(6.)	1840.	8	1840–41.	−3·9	−1·7	4° in Suffolk.
(7.)	1849.	9	1849–50.	+1·2	+0·5	19° „ „
(8.)	1853.	8	1853–54.	−0·5	+0·3	4° at Chiswick.
(9.)	1854.	8	1854–55.	−2·8	−2·9	0° „ „

(1.) "A very severe winter."
(2.) Mr. Glaisher says, "this winter was most severe."
(3.) Mr. Glaisher says, "the frost this winter was excessively severe."
(4.) "Great frost and snow till March 21." (5.) "A severe winter."
(6.) "Severe winter till February 11th."
(7.) "A cold and winterly Christmas, and the month of January was severely cold to the end." (8.) "Severe frosts and snow till January 4th."
(9.) "A severe winter with great snows."

The following facts, coupled with the above tabulated statements, appear to demonstrate the truth of the law I have given relative to winters:—

In 1783 the mean of February was 39°·2, and of March 37°·7; in April it was nearly 48°, and in May 48°·3; in August the mean fell 5°, in September it fell 6°·1, in October 5°·6, and in November 6°·5.

In 1784 the mean of March was 4°·3 above that of February, and in April it rose 5°·8; in May the mean was 56°·8, and in June 56°·2; in July the mean temperature rose 3°·3, and in August it fell 3°·3; in August the mean was 56°·2, and in September 57°·3.

In 1810 the mean of March was 3°·6 above that of February, in April it rose 4°·2, and in May 3°·3; in July the mean was 60°·9, in August 60°·5, and in September 59°·4; in October the mean fell 7°·6, and in November 9°.

In 1812 the mean fell 3°·2 in March, and in April rose 3°·1; in June the mean rose 2°·8, and in July it rose 3°·4; in July the

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mean was 57°·4, in August 57°, and in September nearly 56°; in October it fell 7°·1, and in November 8°·2.

In 1813 the mean of February was 41°·6, of March 43°·1, and of April 43°·8; in June the mean rose 3°, and in July 3°·6; in July the mean was 58°·9, and in August 58°·3; in October the mean fell 7°·2, and in November 7°·1.

In 1822 the mean of March was 47°·3, and in April nearly 47°; in June the mean was 62°·6, in July 62°·5, and in August 61°·3; in September the mean fell 5°·3, in October 4°·6, and in November 3·8.

In 1840 the mean of February was 38°·1, and of March 37°·6; in May the mean rose nearly 6°, and in June 6°; in June the mean was 59°·5, and in July 58°; in September the mean fell 8°, and in October 7°·3.

In 1849 the mean of February was 43°·2, in March 42°·5, and in April 43°·2; in June it rose 3°·9, and in July 4°·2; in July the mean was 62°·1, and in August 62°·9; in October it fell 7°·7, and in November 7°.

In 1853 the mean of March rose 5°·2, in April 6°·7, in May 6°·8, and in June 6°·2; in July it was 60°·3, and in August 60°; in September it fell 4°·7, and in October 4°·4.

In 1854 the mean of March was 4°·3 above that of February, and in April it rose 4°·6, in June it rose 4°·8, and in July 4°·6; in July the mean was 60°·3, and in August 60°·9; in October the mean fell 8°·7, and in November 8°·9.

1. The year that contributed the greatest number of uniform means and differences (viz. 10) was 1794; and the winter of 1794–95 was the coldest on record. The means &c. in 1794 ran thus—in February the mean was 44°·7, in March 44°·3, in April 49·6, and in May 50°·6. In June the mean rose 7°, and in July 7°·7; in August the mean fell 5°·9, in September 5°·7, in October 5°·4, and in November 5°.

2. When the number of uniform means and differences has been 8° or above, the following winter has been very severe, whether the preceding summer has been hot or cold: in such cases of uniformity neither great heat nor unusual cold in the preceding summer exercises any influence on the winter; for, in the eleven years mentioned in the foregoing Table, the summers of 1783, 1794, and 1822 were very hot, and those of 1840 and 1849 were warm. In 1784, 1812, 1813, and 1853 the summers were very cold, and those of 1810 and 1854 were about a medium.

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3. The coldest of each of the five winter months occurred in the winter that commenced in one of the years mentioned in the Tables VIII., IX., and X.

The coldest November on record was in 1782, when the mean temperature was 34°·7.

The coldest December on record was in 1788, when the mean temperature was 29°.

The coldest January on record was in 1795, when the mean temperature was 23°·9.

The coldest February on record was in 1855, when the mean temperature was 29°·4.

The coldest March on record was in 1785, when the mean temperature was 33°·9.

4. Severe winters have almost always followed years distinguished by frequent uniformity of means and differences (in temperature), but have scarcely ever succeeded years that were remarkable for irregularity in those respects.

5. Very mild winters have generally followed years that were remarkable (from February to November) for *irregularity* of means and differences: 1795, 1827, 1842, 1850, and 1858 were remarkable years of this kind, and were followed by very mild winters.

When, from February to October inclusive, two couples of months have been nearly uniform, or when three successive summer months have been nearly uniform, or when five or six months (from February to October) have been distinguished for nearly uniform means, the succeeding December and January have usually a mean temperature below the average. The following are *all* the instances since 1770:—

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Table X.

Year.	Mean Temperature of									Difference of Mean of Dec. and Jan. from the Mean of Fifty Years, which is 38°·3.	Difference of Mean of Dec. and Jan. from the Mean of Ninety-seven Years, which is 37°·6.	Minimum Temperature near London, in Suffolk, or in Hants.
	Feb.	Mar.	April.	May.	June.	July.	August.	Sept.	Oct.			
	°	°	°	°	°	°	°	°	°	°	°	
1771.	33·4	34·7	.....	54·5	54·0	59·5	58·4	.....	.....	−1·5	−0·8	
1772.	.....	.....	.....	.....	59·4	60·0	59·7	.....	.....	−0·1	+0·6	
1775.	41·9	41·7	.....	.....	62·6	63·0	.....	.....	.....	−5·2	−4·5	0° at Selborne.
1779.	45·3	47·0	.....	.....	.....	64·9	63·9	.....	.....	−3·9	−3·2	
1782.	.....	.....	.....	.....	57·9	59·2	56·7	55·5	.....	−1·8	−1·1	
1783.	39·2	37·7	47·9	48·3	.....	.....	.....	.....	.....	−6·2	−5·5	
1784.	.....	.....	.....	56·8	56·2	.....	56·2	57·3	.....	−4·8	−3·1	„ „ „
1786.	.....	.....	.....	.....	59·6	59·0	58·9	.....	.....	−2·0	−1·3	
1788.	38·7	38·6	.....	.....	.....	60·6	59·9	.....	.....	−7·1	−6·4	5° in Suffolk.
1793.	39·7	39·3	.....	.....	.....	.....	.....	52·8	51·9	−1·1	−0·5	
1794.	44·7	44·3	49·6	50·6	.....	.....	.....	.....	.....	−8·0	−7·3	−6° at Clapham.
1796.	39·6	39·0	.....	.....	.....	58·6	59·9	59·1	.....	−5·4	−4·7	−16° in London?
1798.	.....	.....	.....	.....	61·2	61·2	61·5	.....	.....	−4·8	−4·1	2° in Suffolk.
1800.	.....	.....	.....	54·0	55·1	63·2	63·7	.....	.....	+0·5	+1·2	20° „ „
1804.	.....	.....	.....	.....	61·3	60·2	59·9	59·4	.....	−3·3	−2·6	17° „ „
1806.	41·5	40·7	.....	.....	.....	61·2	61·4	.....	.....	+3·4	+4·1	16° „ „
1807.	.....	.....	.....	.....	.....	63·5	63·7	53·1	53·0	−1·5	−0·8	6° „ „
1808.	36·3	37·1	.....	57·1	58·0	.....	.....	.....	.....	−2·6	−0·9	14° „ „
1809.	44·1	42·6	41·1	.....	.....	59·6	58·9	.....	.....	−0·6	+0·1	3° „ „
1810.	.....	.....	.....	.....	.....	60·9	60·5	59·4	.....	−2·6	−1·9	14° at Stratford.
1811.	.....	.....	.....	56·2	57·6	.....	58·5	57·9	.....	−1·1	−0·4	12° in Suffolk.

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TABLE X. (*continued.*)

Year.	Mean Temperature of									Difference of Mean of Dec. and Jan. from the Mean of Fifty Years, which is 38°·3.	Difference of Mean of Dec. and Jan. from the Mean of Ninety-seven Years, which is 37°·6.	Minimum Temperature near London, in Suffolk, or in Hants.
	Feb.	Mar.	April.	May.	June.	July.	August.	Sept.	Oct.			
	°	°	°	°	°	°	°	°	°	°	°	
1812.	.....	.....	.....	.....	.....	57·4	57·0	55·9	.....	−3·6	−2·9	14° in Suffolk.
1813.	.....	43·1	43·8	.....	.....	58·9	58·3	.....	.....	−6·6	−5·9	4° „ „
1814.	34·0	35·1	48·1	48·6	.....	.....	.....	.....	.....	−1·8	−1·1	17° at Tottenham.
1815.	45·0	46·6	.....	.....	.....	59·9	60·4	.....	.....	−1·5	−0·8	−5° „ „
1817.	42·6	41·6	.....	.....	59·1	57·7	55·4	55·5	.....	−0·1	+0·6	3° in Suffolk.
1822.	.....	47·3	46·7	.....	62·6	62·5	61·3	.....	.....	−4·1	−3·5	4° at Tottenham.
1823.	.....	.....	.....	54·6	55·4	59·1	59·8	.....	.....	+0·3	+1·1	19° „ „
1829.	38·4	39·0	.....	.....	59·1	60·1	.....	.....	.....	−5·5	−4·8	8° „ „
1831.	.....	.....	.....	.....	.....	64·3	63·3	56·4	55·0	+1·3	+2·0	20° in Suffolk.
1835.	41·2	41·0	.....	.....	.....	64·4	63·3	.....	.....	−2·3	−1·6	18° „ „
1838.	.....	41·5	41·6	.....	.....	60·5	59·6	.....	.....	−0·4	+0·3	13° at Chiswick.
1840.	38·1	37·6	.....	.....	59·5	58·0	.....	.....	.....	−4·9	−4·2	4° in Suffolk.
1841.	.....	46·2	47·0	56·8	56·4	57·8	.....	.....	.....	−1·6	−0·9	18° at Chiswick.
1844.	.....	.....	51·7	52·9	60·7	61·4	57·7	56·9	.....	−2·7	−2·0	−3° „ „
1846.	43·9	43·3	.....	.....	.....	65·3	64·5	63·2	.....	−4·3	−3·6	4° „ „
1848.	43·4	43·8	.....	59·7	58·5	.....	.....	.....	.....	+3·7	+4·4	16° „ „
1849.	43·2	42·5	43·2	.....	.....	62·1	62·9	.....	.....	−1·9	−1·2	14° „ „
1860.	.....	.....	.....	53·8	54·8	57·6	57·7	.....	.....	−3·3	−2·6	−1° at Chiswick.
1862.	.....	.....	.....	55·4	56·3	59·1	59·5	.....	.....	+4·4	+5·1	14° „ „
*1866.	40·5	40·5	.....	.....	60·9	61·0	.....	.....	.....	+0·1	+0·8	−11° „ „

* A very severe winter.

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There is one other *infallible* rule for the prediction of winters connected with the Greenwich monthly mean temperatures; it is as follows:—When the mean temperature of December is more than 2° above that of November, the remainder of the winter, or rather the winter quarter (consisting of the months of January, February, and March), will always have a mean temperature considerably above the average. The following are all the instances in the last ninety-seven years relative to this rule:—

TABLE XI.

Reference to the Notes.	Year.	Mean Temperature of November.	Mean Temperature of December.	Year of Winter.	Difference of Mean of Jan. to Mar. from the Mean of Ninety-seven Years, which is 38°·5
	1789.	° 38·7	° 41·6	1789–90.	° +2·5
(1.)	1795.	40·7	44·8	1795–96.	+2·8
(2.)	1827.	41·5	44·1	1827–28.	+2·7
(3.)	1842.	42·8	45·0	1842–43.	+1·1
	1851.	37·9	40·4	1851–52.	+2·9
(4.)	1862.	39·8	43·6	1862–63.	+4·1

(1.) "The warmest January on record occurred this winter."
(2.) "A mild winter." (3.) "A mild and stormy January."
(4.) "A remarkably mild winter."

X. *Accounts of the Earthquake which visited the Virgin and adjacent Islands on November 18th, 1867.*

[Extracted chiefly from Official Reports.]

Lieut.-Governor Sir ARTHUR RUMBOLD, Tortola.

ON the 18th of November, 1867, the Virgin Islands were visited by a severe earthquake, which lasted fully fifteen minutes, and was followed by numerous other shocks, less severe, at intervals not exceeding five minutes, for over twelve hours; repeated shocks still occur (November 25), and all appear to come from the north or north-west, save the first, which came from the north-east.

Immediately after the first shock had ceased, the sea receded, or rather sunk, about 4 feet, and immediately rose between 4

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and 5 feet above its original level, submerging the whole of the lowest part of the town, sweeping before it nearly all the smaller dwellings, which had not been entirely destroyed by the late hurricane, or had been replaced in their original positions.

On the sea rising, an excessively strong current set in, first towards the land, then seaward: the first tide and current threw up a quantity of deposit from the sea with a strong sulphurous smell; and from the velocity with which the old lumber and other matters were taken along by the current, I should say it was running at the rate of at least twelve knots. The first and several succeeding shocks were vertical, but the later ones were horizontal in motion.

So far as I have been enabled to ascertain, there is not a stone building of any description in this island which has not been injured in some degree; but with regard to the out islands I have received reports that they have not sustained any injury. At Virgin Garda large blocks of granite were rent during the first shock. At Peter's Island the sea rose to so great a height above its original level that the inhabitants took to their boats and came across to Tortola.

At Salt Island, as in Tortola, the earth was observed to open in several places near the sea-shore, and water rush upwards from the openings. On the hills in Tortola I am told there are some openings caused by the earthquakes.

I have not received any authentic information respecting the earthquakes from any of the neighbouring islands, save St. Thomas, where great losses have been sustained.

J. M. Browne, Esq., Admiralty Bay, Bequia.

Between 4^h and 5^h P.M. (November 18) a tidal wave of unusual dimensions was seen approaching the shore, and it burst with some violence on the beach; this was followed in quick succession by a second and third, each one exceeding the other in velocity and magnitude. The last wave carried everything moveable before it: a large "flat" was left opposite the Police station; two iron tanks were removed about 60 feet from the beach, and masts, boats, logs of wood, &c. were whirled about like feathers on the surface of the water.

The distance inland traversed by the wave was 124 yards; and its depth at the usual high-water mark must have been about 6

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feet. There was no sensible tremor of the earth, though I presume this unusual agitation of the sea must have been occasioned by an earthquake in some quarter.

The direction of the wave was from the south-west, and its course very circumscribed, as it did not affect the adjacent village of Hamilton and was scarcely noticed in Belmont Bay, places situated on opposite sides of the harbour.

I have been informed, by some persons who were working on the heights, that when the wave rose it left a track of dry land behind it; but this may have been mere fancy, or an optical illusion.

Second Account from Bequia (Extracted from the 'Witness' newspaper).

There was no indication of a storm, the harbour reposing in tranquillity, and the sea being as calm and still as a mill-pond unruffled by a breath of wind. Suddenly, and without any apparent cause, the sea was seen to rise gradually from its bed; and having attained a height above the bank, it rushed up impetuously into the town, removing everything that came across the course of the water: iron taches lying on the beach were driven onwards; lighters and boats were floated about the streets, overturning fences, and in some instances removing the foundation of houses. With the same suddenness as it commenced, the waters receded, and, strange to say, went down below the usual tide-level, leaving exposed acres of land which had never been exposed to the eye, except through the clear and transparent waters for which Admiralty Bay is famed. After the lapse of a few moments, the same incident took place a second and third time; the last time, we are told, it reached its acme in point of duration and height. The whole incident lasted about 40 minutes; and there was not the slightest agitation of the water while it lasted.

Lieut.-Governor G. Berkley, St. Vincent.

In this island (on the afternoon of November 18) the water was observed to be unusually high; but nothing occurred to attract special notice. By the mail which arrived on the 20th, I learn that similar appearances manifested themselves as far north as the island of St. Christopher.

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Lieut.-Governor MUNDY, Grenada.

This island was visited, on the 18th of November, with an extraordinary disturbance of the tidal waters round the whole coast. In the port of St. George several volcanic eruptions took place, causing considerable alarm; and the sea overflowed the wharves, knocking down and damaging houses and stores, but happily causing no loss of life.

The following account is condensed from that given by the 'St. George's Chronicle.'

On Monday (November 18) the weather was remarkably close, and the thermometer in the shade stood at 86°, the sea being as smooth as glass up to $5^h\ 20^m$ P.M., when, to the astonishment of every person in the vicinity of the port, an unprecedented fall took place in the tide (which had but shortly before attained high-water mark), of fully 4 to 5 feet, the reef in front of the Lagoon showing its full extent, and the surrounding shores standing out in bold relief for several feet below the usual height. In a very few seconds after the fall of the tide, preceded by a slight rumbling subterraneous noise, the water over the "Green Hole" was seen to rise a few feet and to be in great ebullition; and it was evident that some long-hidden volcanic crater had come into action once more—the huge and angry cauldron forming a regular lake of boiling water between the Spout and the Old Bathing House, whilst a strong sulphurous odour pervaded the air. As quick as thought, the sea again rose to the extent of a little over 4 feet; and six times did this submarine phenomenon show itself in eruption; then it suddenly ceased, everything looking in its direction as if nothing had occurred. Evening setting in, the real amount of damage caused could not then be ascertained; but on the morrow what a picture presented itself! The Carénage, from one end to the other, was strewn with the sides and tops of houses, and lumber of all description; and the boats which the afternoon before lay safely ashore, were all adrift, some seriously injured, and others broken up. The vessels both in the Carénage and the Bay were obliged to be sharply watched; for, at each rise of the water consequent upon fresh explosions from the crater, they spun round as if in a whirlpool. The 'Gem,' the 'Caroline,' and the 'Betha' were in great danger, and were only saved by great efforts; and at the recess of the tide several small craft grounded.

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At 9^h P.M. a shock of earthquake was experienced; and a little before 1^h A.M. of the 19th another shock was felt. These were slight, and undulated perpendicularly.

From Gouyave we have the following account of the effects of the eruption upon that part of the coast.

About 5^h P.M. the sea, with scarce a surf or unusual ripple, began to flow and ebb with astounding rapidity, and at each successive vibration to increase in power, finally reaching in its rise to about 20 feet, and in incursions and recess to about 150 feet, carrying away boats, building-material, walls, trees, rocks, stones, &c. &c.

On the coast near Dougaldstone the sea rose so high that the public bridge was covered, and some cane-fields inundated, where afterwards a large quantity of fish were picked up.

XI. *On the Reduction of Barometer-Readings of Cistern-Barometers with variable level.* By Dr. C. JELINEK, Member of the Imperial Academy of Sciences at Vienna. (Read at the Meeting on the 10th of November, 1867.) Translated by W. T. LYNN, Esq., B.A., F.R.A.S.

[DR. JELINEK, Director of the Imperial Central Meteorological Institute of Vienna, has sent me a copy of the following paper in German, with a request that I would make known something of its contents to the Meteorological Society. He writes that he has found that, in the neutral-point barometers, the "level-correction," or, as it has usually been called in England, the "capacity-correction," has hitherto been determined by an incorrect process, and that the error produced amounts, for a variation of the thermometer of 60° Fahrenheit, to 0·016 English inch.

Although such barometers are no longer used for scientific purposes in England, yet the paper may, perhaps, possess some interest for the Society, both as making known the processes used in Germany, and as pointing out another source of uncertainty in the indications of the barometers formerly in use. I avail myself, therefore, of the President's permission to lay the following translation of Dr. Jelinek's paper before the Society.]

It is well known that Kappeller, at Vienna, constructs cistern-barometers in which the level of the surface of the quicksilver in the cistern is variable, so that in these instruments, besides the temperature-correction, a second also, the so-called "level-correc-

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tion," has to be applied, by which these changes of level are subjected to calculation. On the scale-plate of these barometers there are consequently engraved two numbers, of which the first represents the so-called "neutral point," *i. e.* that reading at which the level-correction is equal to zero, the other a coefficient by which the difference of the reading from the neutral point has to be multiplied. The product is the level-correction, which is to be applied positively for readings above the neutral point, and negatively for readings below it.

The vast majority of the meteorological observation-stations in Austria are provided with such barometers. Similar instruments (by Newman and by Negretti and Zambra) appear to have been introduced in England; and Professor Daniel, in London, had, so early as the year 1823, made use of such a one*.

An accurate theory of this barometer seems not yet to have been given. Kreil, in his 'Introduction to the Meteorological Observations,' applies the level-correction directly to the reading, and then reduces the readings thus corrected to the normal temperature. Baily, in the paper just cited, gives a formula by which the temperature-correction and the level-correction are both to be applied at once to the actual readings.

In order to make clear the difference between the two methods of procedure, it will suffice to set down the formulæ referred to.

Putting l for the actual reading in Paris lines†, t' the temperature of the scale, t that of the quicksilver, in degrees of Réaumur,

$\alpha = 0{\cdot}00022523$ the coefficient of expansion of quicksilver for 1° R.,

$\beta = 0{\cdot}000023475$ the coefficient of expansion of brass,

n the so-called neutral-point of the scale (*i. e.* a constant, for which is usually assumed 340 Paris lines, or 760 millimetres), and

c the proportion of area of the section of the tube to that of the cistern,—

we have, according to Kreil,

$$b' = l + c(l - n),$$

$$b = \frac{1 + \beta(t' - 13)}{1 + \alpha t} \cdot b',$$

* "Description of a New Barometer," &c., by Francis Baily, Esq., Memoirs of the Royal Society. Read November 16, 1837.

† It is very easy to modify all the following formulæ for the cases where millimetres and degrees of Centigrade, or English inches and degrees of Fahrenheit, are read.

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or

$$\text{(I.)} \quad \ldots\ldots\ b=\frac{1+\beta(t'-13)}{1+\alpha t}\,.\,l+c\frac{[1+\beta(t'-13)]}{1+\alpha t}(l-n),$$

in which by b is to be understood the reduced reading of the barometer, or the actual atmospheric pressure.

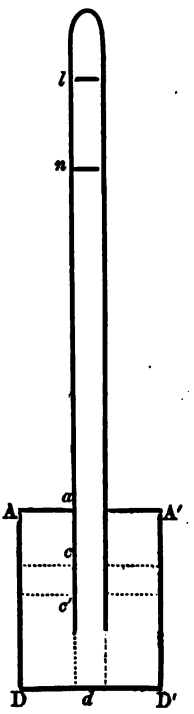
According to Baily, the formula for reduction is

$$\text{(II.)} \quad \ldots\ldots\ b=\frac{1+\beta(t'-13)}{1+\alpha t}\,.\,l+c(l-n).$$

It is obvious that, when these formulæ were drawn up, it was not brought into consideration which of the two corrections should first be applied. Another formula might as reasonably be introduced founded upon the hypothesis that first the temperature and afterwards the level-correction ought to be applied. The formula in question would be

$$\text{(III.)} \quad \ldots\ldots\ b=\frac{1+\beta(t'-13)}{1+\alpha t}\,.\,l+c\left[\frac{1+\beta(t'-13)}{1+\alpha t}\,.\,l-n\right].$$

Before proceeding to the investigation of the correct formula, it will be necessary to devote a few preliminary words to the construction of Kappeller's barometer. In it the glass-tube is supported above the cistern by a wooden tube, and firmly cemented near the point *a*. The (porous) wooden covering-plate of the glass cistern is glued to the wooden tube. Both the glass tube and the cistern are placed in a brass cell, and the cistern is pressed by means of a sheet of cork placed below, through the bottom plate D D′, against the upper brass plate A A′. The above-mentioned wooden tube is also screwed on near near the point *a*.



From this description it is evident that if, in consequence of changes of temperature, a different expansion of the glass and brass parts of the barometer takes place, the fixed point of the intrument must be sought for on the brass-plate A A′ [below it]. As the brass is more expanded than the glass, it follows that, in an increasing temperature, the brass cell will push a little upwards, reckoning from the point *a*, against the glass

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tube; below the point a, the brass cell A A′ D D′ of the cistern will expand more rapidly than the glass cistern, and therefore the extension of the piece of cork below will be smaller.

This being supposed, we will denote by γ the coefficient of expansion of glass, and by n the so-called neutral point of the scale.

Let us consider the scale (upon the brass cell) to be, as well as the glass tube and cistern, at a determinate temperature—for instance, at 13° R. To the point a corresponds a certain division-mark on the scale; say a. Let us now conceive a units of length upon the glass tube to be carried downwards from the point a; we shall thus obtain a point c, which will define for us the zero-point of the scale. At the same normal temperature (13° R.), let the distance* of the zero-point c from the bottom d of the glass cistern be equal to e.

It is now evident that, at the normal temperature, we must have the lengths

$$nc=na+ac=n,$$

$$nd=nc+cd=n+e.$$

But at another temperature, t', these lengths take the following values:—

$$na=(n-a)[1+\beta(t'-13)],$$

$$ac=a[1+\gamma(t'-13)],$$

$$cd=e[1+\gamma(t'-13)],$$

and

$$ad=(a+e)[1+\gamma(t'-13)].$$

Now suppose that, at a certain atmospheric pressure b, and at a temperature of the quicksilver equal to t, the surface of the quicksilver in the tube reaches to l, corresponding to a division-mark l, and in the cistern to c'.

We will denote the height of the column of quicksilver ld in the glass tube by H; this is given by the expression

$$\text{(1.)} \quad \ldots\ldots \quad H=ld=la+ad=(l-a)[1+\beta(t'-13)] + (a+e)[1+\gamma(t'-13)].$$

If we call $x=cc'$ the distance of the level from the zero-point c,

* For simplicity's sake, the glass tube may be regarded as reaching to the bottom of the cistern, although this is not actually the case.

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measured on the glass tube at the normal temperature 13° R., then this distance for another temperature t' will be

$$cc'=x[1+\gamma(t'-13)].$$

The height $c'd$ of the quicksilver in the cistern, which we will call h, will be

(2.) ..... $h=c'd=cd-cc'=(e-x)[1+\gamma(t'-13)]$.

If the quicksilver were at the temperature 0° R., the atmospheric pressure would be equal to $H-h$; but as the quicksilver is at the temperature t, the atmospheric pressure b is equal to

(3.) ..... $b=\frac{H-h}{1+\alpha t}$.

In this formula, the quantity h depends upon the unknown quantity x. In order to determine x, we proceed upon the consideration that *the quantity of quicksilver contained in the barometer is invariable.* Calling

D the interior diameter of the glass cistern,
d' the exterior " " " tube,
d the interior " " " "

all being at the normal temperature of 13°,

s the specific gravity of quicksilver at the temperature 0°,

—the weight of the quicksilver contained in the tube*, supposing it at the temperature t', will be

$$\tfrac{1}{4}\pi d^2[1+\gamma(t'-13)]^2 . H . \frac{s}{1+\alpha t},$$

the weight of the quicksilver in the cistern

$$\tfrac{1}{4}\pi(D^2-d'^2)[1+\gamma(t'-13)]^2 . h . \frac{s}{1+\alpha t},$$

and therefore the whole weight

(4.) ..... $\frac{1}{4}\pi\frac{[1+\gamma(t'-13)]^2 s}{1+\alpha t}[d^2H+(D^2-d'^2)h]=C$

where C denotes a constant.

This formula (4) holds good for all cases; and therefore, when we are regarding the particular case in which the temperature of the scale and of the parts consisting of glass is equal to 13°, that of the quicksilver =0°, and the atmospheric pressure =n,

* We are still assuming that the glass tube reaches down to the bottom of the cistern. The error produced by this assumption is indeed quite insensible.

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in this case we have

$$1+\gamma(t'-13)=1,$$
$$1+\alpha t \quad =1,$$
$$H=nd=n+e,$$
$$h=cd=e;$$

therefore

(5.) ..... $\frac{1}{4}\pi s[d^2(n+e)+(D^2-d^2)e]=C;$

and if, for shortness' sake, we put

(6.) ..... $c=\frac{d^2}{D^2-d^2},$

where c has the same signification as is assigned to it at the beginning, there results from the two equations (4) and (5)

$$[1+\gamma(t'-13)]^2\cdot\left(\frac{h+cH}{1+\alpha t}\right)=e+c(n+e),$$

or

(7.) ..... $\frac{h}{1+\alpha t}=-\frac{cH}{1+\alpha t}+\frac{e+c(n+e)}{[1+\gamma(t'-13)]^2}.$

By substituting this value in equation (3), we find the atmospheric pressure corresponding to the reading l at the temperature t' of the scale and of the tube*, and at the temperature t of the quicksilver,

(8.) ..... $b=\frac{(1+c)H}{1+\alpha t}-\frac{[cn+(1+c)e]}{[1+\gamma(t'-13)]^2},$

or also

(9.) ..... $b=\frac{H}{1+\alpha t}-\frac{e}{[1+\gamma(t'-13)]^2}+c\left[\frac{H}{1+\alpha t}-\frac{(n+e)}{[1+\gamma(t'-13)]^2}\right],$

in which formulæ the value of H is to be substituted from (1).

It is always permissible to put, in formula (1), $a=0$,—that is, to remove the fixed point of the barometer to the zero-point of the scale. In doing this, we only do what has heretofore been done with all barometers of Fortin's construction, in which, also, for the short ivory point, instead of the expansion of the ivory, that of the brass scale is taken. In section the value of a in several such barometers was equal to 14·6 lines (33 millimetres).

* The formulæ may easily be modified for the case in which the temperatures of the scale and of the glass tube are different.

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The error which is committed by the neglect in question is therefore equal to

$$-\frac{a(\beta-\gamma)(t'-13)}{1+at},$$

or, under the assumptions

$a=14{\cdot}6$ lines, $\beta=0{\cdot}000023475$, $\gamma=0{\cdot}00001147$,

for $t=t'=-6°$, equal to $+0{\cdot}0033$ line,

for $t=t'=+24°$, „ $-0{\cdot}0019$.

On this supposition, the formula (1) stands more simply thus:—

(10.)..... $H=b[1+\beta(t'-13)]+c[1+\gamma(t'-13)]$.

Neglecting the second powers of the very small quantities α and γ, and putting

(11.)..... $b'=\frac{b[1+\beta(t'-13)]}{1+at}-c[at-\beta\gamma(t'-13)]$,

the atmospheric pressure b will be given by the formula

(12.)..... $b=b'+c(b'-n)$.

In this last formula, in place of

$$\frac{cn}{[1+\gamma(t'-13)]^2}$$

simply cn has been substituted. The error thereby committed is

$$2cn\gamma(t'-13).$$

Putting

$$c=0{\cdot}06, \quad n=336{\cdot}905 \text{ lines.}, \quad \gamma=0{\cdot}00001147,$$

the amounts of error will be

for $t'=-6$, $-0{\cdot}0088$ line.,

„ $t'=+24$, $+0{\cdot}0051$,

that is, in the two extreme cases, to less than one-hundredth of a line.

In formula (11) the first term

$$\frac{b[1+\beta(t'-13)]}{1+at}$$

denotes the reading corrected for temperature. We see therefore that formulæ (11) and (12) here deduced agree essentially

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with that referred to as III. The only difference consists in this, that, in addition to the term

$$\frac{l[1+\beta(t'-13)]}{1+\alpha t}$$

of formula III., there occurs also, in some degree as a correction, another term,

$$-e[\alpha t-3\gamma(t'-13)].$$

Now, as to the value of this term, it is given, on the assumption $e=35{\cdot}4$ lines $=80$ millimetres (which value has sectionally been found by measures on some such barometers),

$$\text{for } t=t'=-6°, \quad \text{equal to } +0{\cdot}025 \text{ line.},$$

$$\text{,, } t=t'=+24°, \quad \text{,,} \quad -0{\cdot}178;$$

in no case therefore can it be neglected.

In order to be able to carry out the complete reduction of the indications of Kappeller's cistern-barometer with variable level according to the above formulæ—

$$\text{(IV.)}\ldots\ldots \begin{cases} b'=\dfrac{l[1+\beta(t'-13)]}{1+\alpha t}-e[\alpha t-3\gamma(t'-13)], & \text{and} \\ b=b'+c(b'-n),— \end{cases}$$

it is requisite to know the value, not only of the quantities n and c (which, as already mentioned, are engraved on the scale-plate of the barometer), but also that of the quantity e (depth of the bottom of the cistern below the zero-point of the division), and γ the coefficient of expansion of the glass. The quantity e is found with a sufficient degree of accuracy for the purpose before us by measuring with a rod the distance of any one division-mark, as l, from the bottom of the cistern. The length obtained in this manner is that of $l+e$; as l is known, e is at once deduced. As to the coefficient of expansion γ of the glass, this is of course somewhat different for different kinds of glass; γ, however, is in itself small; and, in the value assumed for it, the outstanding uncertainty can produce no appreciable influence upon the result.

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XII. *On the Prevalence of Rain, Thunder, Lightning, and Fog on the South Atlantic, North Atlantic, and a part of the North Pacific Oceans.* By FREDERIC GASTER, Esq., F.M.S.

IN June 1866, I laid before this Society a paper relating to the prevalence of rain over that portion of the ocean-surface referred to in the accompanying Tables, and promised on that occasion to compute in a similar manner the percentage of calm, thunder, lightning, and fog. For a variety of reasons the publication of this work has been delayed for a considerable time; but some of the results are now offered with a few remarks on their value.

It will perhaps be better to restate that the observations are obtained from the 'Storm and Rain Charts' compiled by Capt. Maury, and that what I have done has been to calculate the percentage values for the various phenomena, the numerical values of which were given in the charts referred to. Great facility is thereby given for intercomparing the prevalence of these meteorological conditions in different parts of the world, and the whole are given in a more available form than they were. The necessity of allowing for the difference in the number of observations taken in various squares is thus dispensed with—except as showing how far the values derived from them may be considered reliable.

I do not propose on the present occasion to say much with regard to the distribution of these phenomena, nor to refer to those peculiarities of the atmospheric circulation to which they point; but I hope very shortly to produce a paper on the subject, based to a certain extent on the figures here given, and to include on that occasion the results of other and more accurate observations which have been published since Maury published his.

In Tables I., II., and III. the arrangement is as follows:—The first column contains the total number of observations of all kinds of weather made in the 5° square in which they are placed; the second column gives the number of different months represented; and the remaining four columns give the percentage of those observations in which rain, calm, thunder and lightning, or fog was recorded. The values for the rain have been recalculated, and some slight errors (none amounting to 1 per cent.) in them have been removed.

The prevalence of thunder and lightning is scarcely so great as might have been anticipated; and it would appear that some doubt has been entertained, even by Maury himself, as to whether the

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occurrence of such conditions as fog, thunder, &c. had always been noted in the logs from which the observations were extracted. Thus, on p. 318 of his 'Sailing Directions' (vol. i. 8th ed.) we find the following remark:—

"It may be that mariners do not *always* record in their logs rain, fog, thunder or lightning. They do always mention gales and calms, and the quadrant whence the wind blows. It may therefore be probable that both rains and lightning occur at sea more frequently than it would appear by the charts they do; if so, I have no means of knowing until I shall have received many thousands of abstract logs, faithfully kept according to the form recommended by the Brussels Conference, and now universally used at sea wherever there is a vessel commanded by a master capable of appreciating his duties and the importance of a great work like this. But it may be presumed that mariners generally are not more apt to neglect to mention rain, thunder, and fogs in one part of the ocean than another, and therefore that the relative frequency with which they occur may be supposed to be fairly indicated on the chart."

The Dutch authority, K. F. R. Andrau, subsequently applied a test in order to decide whether the American observations should be included in a somewhat similar series of charts which were being prepared by the Netherlands Meteorological Institute. The following is a translation of the statement made by him in the "Introduction" appended to the charts when published*.

"The rain-, thunder-, and fog-charts have been composed more exclusively from Dutch data. We have designedly kept Maury's data separate, and at the same time kept all the observations out of our own logs quite to themselves, in order that we might by the intercomparison of the two results arrive at the certainty that the logs do not *always* contain a true account of the phenomena. Inasmuch as these logs are intended less for a record of meteorological phenomena than to serve as a justification for the captain, it is intelligible that observations concerning rain, thunder, and fog will be recorded with less accuracy than the phenomena of storms, which influence the sailing-powers of the ship so seriously.

"We thought it better on this account to confine the investigation of the phenomena to a smaller number of observations†, but

* Verzameling van Kaarten Inhoudende eene procentogewijze opgave omtrent Storm, Regen, Donder, en Mist, &c. &c. 1862.

† Maury's observations of storms *were included* by the Dutch in their Chart; the calms were not discussed.

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those of better quality, than to extend them over a larger amount of material which was not quite so trustworthy. We have therefore confined ourselves to the new logs (the true meteorological Registers) for all that concerns the rain, thunder, and fog.

"In order to construct the charts, 37,944 American observations for the west portion of the N. Atlantic ocean were employed, and were treated separately; and then 492,418 Dutch observations for the same parts of the ocean were discussed. This amount of materials, which may be considered small in comparison with that for which the storm-chart was constructed, is yet large enough to give us confidence in the results as to each phenomenon by itself, and as to the comparative frequency or rarity of its occurrence."

The *only* object in making these extracts is to prevent any one from attaching undue weight to the figures given in these Tables. There appears no reason to doubt that the original intent of Maury's charts, viz. to exhibit the "*relative* prevalence" of rain &c., is *well* carried out; and too much can scarcely be said in praising the untiring zeal and assiduity displayed in their preparation, or the *vast* benefits which have resulted from them to meteorology and to the seafaring community at large. If in no other way notable, the impetus which the publication of these and the wind- and current-charts gave to the investigation of the circulation of the atmosphere, and the currents of the ocean, is sufficient to make the name of Maury one which will in all ages stand one of the first on the list of those who have written and worked on the subject.

What I propose to do in a future paper, however, is to take first the figures given in the Dutch charts (which are sufficiently numerous to show bi-monthly percentages), and, making use of the general laws which are shown in the accompanying Tables for the whole year, to draw attention to what may possibly be the causes of the distribution of the phenomena shown, and to use their comparative frequency in one part of the world over that in another in order to trace out some other facts which may not be without their value.

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TABLE I. Prevalence of Rain, Calm, Thunder and Lightning, and Fog in each Square of 5° Latitude and Longitude on the SOUTH ATLANTIC.

Longitude.	Lat. 0°–5° S.						Lat. 5°–10° S.					
	Total observations.	Months.	Percentage of				Total observations.	Months.	Percentage of			
			Rain.	Calm.	Thunder and Lightn.	Fog.			Rain.	Calm.	Thund. and Lightn.	Fog.
° °												
15–20 E.	...	...	...	...	...	...	...	...	...	...	...	...
10–15	...	...	...	...	...	...	24	2	4·2	0·0	0·00	0·00
5–10	12	3	0·0	0·0	0·00	8·33	15	1	6·7	0·0	0·00	0·00
0– 5 E.	27	2	0·0	11·1	0·00	0·00	18	3	0.0	0·0	0·00	0·00
0– 5 W.	15	3	0·0	26·7	0·00	0·00	6	1	0·0	0·0	0·00	0·00
5–10	60	5	5·0	5·0	0·00	0·00	18	2	0·0	0·0	0·00	0·00
10–15	90	5	0·0	0·0	0·00	0·00	300	11	3·0	1·0	0·00	0·00
15–20	579	12	3·1	1·0	0·52	0·00	1,149	12	2·2	0·3	0·00	0·00
20–25	2,079	12	6·1	2·5	0·58	0·14	1,674	12	4·5	0·3	0·00	0·00
25–30	3,546	12	7·3	2·7	0·42	0·08	2,199	12	3·0	0·2	0·09	0·00
30–35	2,451	12	8·9	2·6	0·53	0·04	4,094	12	7·8	1·5	0·27	0·00
35–40	1,635	12	11·7	2·3	0·67	0·06	273	12	3·7	2·6	0·00	0·00
40–45	85	9	7·1	2·4	0·00	0·00	...	...	...	...	...	...
45–50	...	...	...	...	...	...	...	...	...	...	...	...
50–55	...	...	...	...	...	...	...	...	...	...	...	...
55–60	...	...	...	...	...	...	...	...	...	...	...	...
60–65	...	...	...	...	...	...	...	...	...	...	...	...
65–70 W.	...	...	...	...	...	...	...	...	...	...	...	...
Total Obs. ...	10,579	...	825	269	54	9	9,770	...	509	85	13	0
Mean Percentages in 5° zones ...	...	...	7·8	2·5	0·51	0·09	...	...	5·2	0·9	0·13	0·00

Longitude.	Lat. 10°–15° S.						Lat. 15°–20° S.					
	Total observations.	Months.	Percentage of				Total observations.	Months.	Percentage of			
			Rain.	Calm.	Thunder and Lightn.	Fog.			Rain.	Calm.	Thund. and Lightn.	Fog.
° °												
15–20 E.	...	...	...	...	...	...	...	...	...	...	...	...
10–15	...	...	...	...	...	...	...	...	...	...	...	...
5–10	...	...	...	...	...	...	39	3	0·0	0·0	0·00	0·00
0– 5 E.	15	3	6·7	0·0	0·00	0·00	192	8	0·4	2·6	0·00	0·00
0– 5 W.	33	4	0·0	0·0	0·00	0·00	1,545	12	2·1	1·6	0·00	0·06
5–10	753	12	2·5	0·7	0·00	0·13	1,371	12	4·7	2·4	0·00	0·07
10–15	1,438	12	4·0	0·8	0·00	0·00	303	12	11·2?	3·3	0·00	0·66
15–20	798	12	3·9	0·0	0·00	0·00	153	10	3·9	2·6	0·00	0·00
20–25	414	12	1·7	0·5	0·00	0·00	363	12	3·6	3·0	0·28	0·00
25–30	1,444	12	2·9	0·3	0·00	0·00	1,812	12	4·5	2·8	0·06	0·00
30–35	3,780	12	4·7	2·0	0·13	0·00	3,412	12	6·8	2·5	0·12	0·06
35–40	1,011	12	6·2	4·3	0·49	0·40	3,941	12	7·1	3·3	0·36	0·05
40–45	...	...	...	...	...	...	...	...	...	...	...	...
45–50	...	...	...	...	...	...	...	...	...	...	...	...
50–55	...	...	...	...	...	...	...	...	...	...	...	...
55–60	...	...	...	...	...	...	...	...	...	...	...	...
60–65	...	...	...	...	...	...	...	...	...	...	...	...
65–70 W.	...	...	...	...	...	...	...	...	...	...	...	...
Total Obs. ...	9,686	...	397	140	10	5	13,131	...	741	356	21	8
Mean Percentages in 5° zones ...	...	...	4·1	1·4	0·10	0·05	...	...	5·6	2·7	0·16	0·06

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TABLE I. (*continued.*) Prevalence of Rain, Calm, Thunder and Lightning, and Fog in each Square of 5° Latitude and Longitude on the SOUTH ATLANTIC.

Longitude.	Lat. 20°–25° S.						Lat. 25°–30° S.					
	Total observations.	Months.	Percentage of				Total observations.	Months.	Percentage of			
			Rain.	Calm.	Thunder and Lightn.	Fog.			Rain.	Calm.	Thunder and Lightn.	Fog.
° °												
15–20 E.	...	...	...	...	...	...	15	3	6·7	6·7	0·00	0·00
10–15	30	6	6·7	3·3	0·00	13·33	561	12	2·1	2·7	0·00	0·53
5–10	363	12	2·8	1·7	0·00	0·83	1,569	12	1·7	3·1	0·25	0·32
0– 5 E.	1,569	12	1·2	2·9	0·00	0·13	462	12	3·0	3·2	0·00	0·00
0– 5 W.	861	12	5·0	2·1	0·00	0·00	231	7	5·2	3·5	0·00	0·00
5–10	156	10	3·8	3·2	1·92	0·00	141	9	5·0	4·3	0·00	0·00
10–15	69	6	0·0	1·5	0·00	0·00	213	10	3·3	3·8	0·00	0·00
15–20	195	8	3·6	2·6	0·00	0·00	594	12	5·7	2·2	0·17	0·17
20–25	770	12	4·0	3·1	0·26	0·00	1,200	12	6·9	2·6	0·08	0·33
25–30	2,574	12	6·7	4·1	0·19	0·16	1,791	12	6·0	3·2	0·67	0·28
30–35	2,789	12	7·5	3·6	0·57	0·14	2,119	12	7·8	4·5	0·61	0·05
35–40	3,323	12	7·0	4·4	0·84	0·18	2,223	12	10·0	3·8	1·35	0·40
40–45	1,313	12	4·1	8·1	1·60	0·53	2,193	12	7·8	7·9	1·69	0·18
45–50	...	...	...	...	...	...	884	12	8·6	4·5	1·47	0·00
50–55	...	...	...	...	...	...	...	...	...	...	...	...
55–60	...	...	...	...	...	...	...	...	...	...	...	...
60–65	...	...	...	...	...	...	...	...	...	...	...	...
65–70 W.	...	...	...	...	...	...	...	...	...	...	...	...
Total Obs. ...	14,012	...	785	563	75	30	14,196	...	943	594	111	32
Mean Percentages in 5° zones ...	...	...	5·6	4·0	0·54	0·21	...	...	6·6	4·2	0·78	0·23

	Lat. 30°–35° S.						Lat. 35°–40° S.					
° °												
15–20 E.	1,500	12	2·1	4·2	0·60	0·40	2,976	12	4·4	3·0	0·17	0·74
10–15	3,232	12	2·3	3·0	0·15	0·93	1,857	12	5·8	3·8	0·05	0·70
5–10	1,968	12	3·2	4·7	0·10	0·66	2,454	12	4·8	4·0	0·00	1·63
0– 5 E.	897	12	5·9	4·8	0·11	0·33	2,442	12	6·1	2·8	0·00	3·44
0– 5 W.	819	12	6·7	2·1	0·12	0·61	2,628	12	6·1	2·5	0·08	2·55
5–10	897	12	6·5	2·8	0·00	1·11	2,085	12	5·8	2·2	0·00	1·92
10–15	1,176	12	6·0	2·5	0·09	0·34	2,064	12	5·9	3·4	0·29	2·86
15–20	1,506	12	6·6	3·5	0·40	0·13	1,570	12	5·5	2·6	0·51	3·50
20–25	1,656	12	6·5	2·1	0·24	1·21	2,145	10	7·4	2·7	0·05	2·00
25–30	1,101	12	6·8	2·9	0·19	1·91	1,045	10	9·7	2·3	0·00	2·58
30–35	1,248	12	7·7	3·8	1·52	1·36	654	12	5·6	2·5	0·00	1·07
35–40	1,732	12	8·6	4·2	0·93	0·93	1,485	12	6·7	4·2	0·61	0·74
40–45	2,397	12	7·8	4·9	1·13	1·21	2,319	12	5·7	4·1	0·39	1·03
45–50	2,406	12	7·3	4·9	1·08	0·79	3,357	12	6·1	4·4	2·00	1·82
50–55	837	12	6·2	6·2	3·46	1·55	2,046	12	5·1	4·3	1·81	2·10
55–60	...	...	...	...	...	...	504	12	3·8	6·0	3·77	6·35
60–65	...	...	...	...	...	...	...	...	...	...	...	...
65–70 W.	...	...	...	...	...	...	...	...	...	...	...	...
Total Obs. ...	23,372	...	1347	893	148	198	31,631	...	1850	1070	164	628
Mean Percentages in 5° zones ...	...	...	5·8	3·8	0·63	0·85	...	...	5·8	3 4	0·52	1·99

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TABLE I. (*continued.*) Prevalence of Rain, Calm, Thunder and Lightning, and Fog in each Square of 5° Latitude and Longitude on the SOUTH ATLANTIC.

Longitude.	Lat. 40°–45° S.						Lat. 45°–50° S.					
	Total observations.	Months.	Percentage of Rain.	Calm.	Thunder and Lightn.	Fog.	Total observations.	Months.	Percentage of Rain.	Calm.	Thunder and Lightn.	Fog.
° °												
15–20 E.	141	9	14·9	1·4	0·00	0·00	...	...	...	...	...	...
10–15	159	8	5·7	3·8	0·00	1·89	...	...	...	...	...	...
5–10	490	8	3·9	1·8	0·00	2·04	...	...	...	...	...	...
0– 5 E.	381	5	10·0	1·8	0·00	1·31	...	...	...	...	...	...
0– 5 W.	876	4	3·3	3·5	0·00	3·88	...	...	...	...	...	...
5–10	288	4	1·8	0·3	0·00	0·00	...	...	...	...	...	...
10–15	99	4	0·0	3·0	0·00	0·00	...	...	...	...	...	...
15–20	9	2	0·0	0·0	0·00	0·00	...	...	...	...	...	...
20–25	33	2	0·0	0·0	0·00	9·09	...	...	...	...	...	...
25–30	54	5	7·5	0·0	0·00	3·7c	...	...	...	...	...	...
30–35	99	4	5·0	2·0	0·00	3·03	...	...	...	...	...	...
35–40	474	11	9·7	4·6	0·42	1·90	30	6	6·7	10·0	0·00	16·67
40–45	1,546	12	6·5	2·7	0·65	1·42	165	11	10·9	3·6	0·00	4·24
45–50	1,969	12	6·7	4·7	0·46	0·96	933	12	7·8	3·1	0·11	1·50
50–55	2,250	12	5·9	5·4	1·60	2·22	1,398	12	6·8	2·6	0·72	3·22
55–60	2,182	12	5·2	5·3	1·51	5·90	1,875	12	5·5	3·4	0·53	5·55
60–65	804	12	3·7	6·2	0·87	2·11	2,077	12	5·4	4·5	1·30	2·07
65–70 W.	...	...	...	...	...	...	198	11	4·5	6·1	0·52	0·52
Total Obs. ...	11,854	...	686	505	97	306	6,676	...	413	244	49	219
Mean Percentages in 5° zones ...	...	...	5·8	4·3	0·82	2·58	...	...	6·2	3·7	0·73	3·28

Longitude.	Lat. 50°–55° S.						Lat. 55°–60° S.					
° °												
15–20 E.	...	...	...	...	...	...	...	...	...	...	...	...
10–15	...	...	...	...	...	...	...	...	...	...	...	...
5–10	...	...	...	...	...	...	...	...	...	...	...	...
0– 5 E.	...	...	...	...	...	...	...	...	...	...	...	...
0– 5 W.	...	...	...	...	...	...	...	...	...	...	...	...
5–10	...	...	...	...	...	...	...	...	...	...	...	...
10–15	...	...	...	...	...	...	...	...	...	...	...	...
15–20	...	...	...	...	...	...	...	...	...	...	...	...
20–25	...	...	...	...	...	...	...	...	...	...	...	...
25–30	...	...	...	...	...	...	...	...	...	...	...	...
30–35	...	...	...	...	...	...	...	...	...	...	...	...
35–40	...	...	...	...	...	...	...	...	...	...	...	...
40–45	...	...	...	...	...	...	...	...	...	...	...	...
45–50	108	12	10·0	1·9	0·00	12·04	...	...	...	...	...	...
50–55	948	12	13·5	2·4	0·00	6·01	27	6	14·8	3·7	0·00	0·00
55–60	1,680	12	10·4	3·0	0·12	3·39	405	12	12·6	3·2	0·00	4·94
60–65	2,781	12	7·3	4·1	0·40	3·09	2,598	12	13·9	4·0	0·42	2·62
65–70 W.	708	12	6·1	4·9	0·28	2·82	4,407	12	16·0	3·5	0·34	2·36
Total Obs. ...	6,225	...	560	225	15	233	7,437	...	1109	271	26	192
Mean Percentages in 5° zones ...	...	...	9·0	3·6	0·24	3·74	...	...	14·9	3·6	0·35	2·58

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TABLE II. Prevalence of Rain, Calm, Thunder and Lightning, and Fog in each Square of 5° Latitude and Longitude on the NORTH ATLANTIC.

Longitude.	Lat. 0°–5° N.						Lat. 5°–10° N.					
	Total observations.	Months.	Percentage of Rain.	Calm.	Thunder and Lightn.	Fog.	Total observations.	Months.	Percentage of Rain.	Calm.	Thunder and Lightn.	Fog.
° ° 5–10 E.	222	5	10·8	8·1	1·35	0·00	...	...	...	...	...	...
0– 5 E.	98	7	8·1	5·1	1·02	0·00	55	2	1·8	1·8	0·00	0·00
0– 5 W.	233	11	12·4	8·6	3·86	0·00	70	5	4·3	2·9	0·00	0·00
5–10	362	12	14·4	8·6	0·83	0·00	80	6	17·5	8·8	0·00	0·00
10–15	107	10	11·2	6·5	2·80	0·00	716	11	22·8	8·8	0·84	0·00
15–20	335	11	11·3	5·7	1·79	0·00	483	11	13·5	8·3	0·21	0·00
20–25	1,262	12	11·5	13·0	2·54	0·00	1,109	12	18·7	10·9	1·08	0·00
25–30	2,004	12	15·6	12·8	2·00	0·00	1,667	12	15·4	11·7	2·52	0·00
30–35	1,004	12	17·8	9·7	1·29	0·00	739	12	15·6	7·3	1·89	0·00
35–40	613	12	13·4	6·0	0·65	0·00	632	12	15·7	7·0	2·53	0·00
40–45	421	11	21·4	2·4	1·90	0·00	668	12	16·3	3·6	0·90	0·00
45–50	95	7	9·5	5·3	0·00	0·00	289	11	13·5	0·3	0·35	0·00
50–55	...	...	...	...	...	...	...	...	...	...	...	...
55–60	...	...	...	...	...	...	23	3	13·1	13·0	0·00	0·00
60–65	...	...	...	...	...	...	...	...	...	...	...	...
65–70	...	...	...	...	...	...	...	...	...	...	...	...
70–75	...	...	...	...	...	...	...	...	...	...	...	...
75–80	...	...	...	...	...	...	...	...	...	...	...	...
80–85	...	...	...	...	...	...	...	...	...	...	...	...
85–90	...	...	...	...	...	...	...	...	...	...	...	...
90–95	...	...	...	...	...	...	...	...	...	...	...	...
95–100 W.	...	...	...	...	...	...	...	...	...	...	...	...
Total Obs. ...	6,756	...	1001	670	122	...	6,531	...	1075	555	98	...
Percentages	...	...	14·8	9·9	1·81	0·00	...	...	16·5	8·5	1·50	0·00

	Lat. 10°–15° N.						Lat. 15°–20° N.					
° ° 5–10 E.	...	...	...	...	...	...	...	...	...	...	...	...
0– 5 E.	...	...	...	...	...	...	...	...	...	...	...	...
0– 5 W.	...	...	...	...	...	...	...	...	...	...	...	...
5–10	...	...	...	...	...	...	...	...	...	...	...	...
10–15	...	...	...	...	...	...	...	...	...	...	...	...
15–20	225	9	4·9	9·3	1·33	0·00	6	1	0·0	0·0	0·00	0·00
20–25	622	12	7·9	5·0	0·48	0·00	159	11	0·6	1·3	0·63	0·00
25–30	833	12	5·9	5·5	0·24	0·00	638	12	4·4	2·4	0·00	0·00
30–35	667	12	6·1	4·2	1·95	0·00	711	12	3·4	2·7	0·70	0·00
35–40	415	12	9·6	6·0	2·17	0·00	449	12	5·2	5·1	0·00	0·00
40–45	508	12	11·4	3·9	3·54	0·00	302	11	11·6	2·3	0·99	0·00
45–50	594	12	6·9	0·7	0·67	0·00	326	12	5·5	3·4	0·92	0·00
50–55	387	12	4·8	3·9	1·03	0·00	541	12	5·2	3·1	0·55	0·00
55–60	96	10	1·0	1·0	0·00	0·00	459	12	7·4	1·3	0·22	0·00
60–65	53	5	7·5	7·5	0·00	0·00	183	10	7·7	1·6	2·73	0·00
65–70	53	4	0·0	0·0	0·00	0·00	152	10	5·3	3·9	1·32	0·00
70–75	...	...	...	...	...	...	320	12	5·9	7·8	2·81	0·00
75–80	65	8	15·4	0·0	0·00	0·00	243	11	7·8	7·1	0·82	0·00
80–85	69	4	2·9	2·9	0·00	0·00	102	9	2·9	1·0	0·00	0·00
85–90	...	...	...	...	...	...	...	...	...	...	...	...
90–95	...	...	...	...	...	...	25	3	8·0	8·0	0·00	0·00
95–100 W.	...	...	...	...	...	...	81	9	11·1	9·9	1·23	0·00
Total Obs. ...	4587	...	324	197	56	...	4,697	...	265	162	35	...
Percentages	...	...	7·1	4·2	1·22	0·00	...	...	5·6	3·4	0·75	0·00

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TABLE II. (*continued*). Prevalence of Rain, Calm, Thunder and Lightning, and Fog on each Square of 5° Latitude and Longitude in the NORTH ATLANTIC.

Longitude.	Lat. 20°–25° N.						Lat. 25°–30° N.					
	Total observations.	Months.	Percentage of				Total observations.	Months.	Percentage of			
			Rain.	Calm.	Thunder and Lightn.	Fog.			Rain.	Calm.	Thunder and Lightn.	Fog.
° °												
5–10 E.	...	...	...	...	...	...	...	...	...	...	...	...
0– 5 E.	...	...	...	...	...	...	...	...	...	...	...	...
0– 5 W.	...	...	...	...	...	...	...	...	...	...	...	...
5–10	...	...	...	...	...	...	...	...	...	...	...	...
10–15	...	...	...	...	...	...	...	...	...	...	...	...
15–20	15	4	0·0	0·0	0·00	0·00	87	9	8·0	8·0	0·00	0·00
20–25	136	12	0·7	0·7	0·00	0·00	151	9	4·6	9·3	0·00	0·00
25–30	338	12	4·4	3·0	0·00	0·00	209	11	6·7	2·4	0·96	0·48
30–35	664	12	5·1	3·9	0·30	0·00	663	12	6·6	6·6	0·90	0·00
35–40	805	12	6·7	7·3	0·99	0·00	958	12	9·8	4·4	3·03	0·00
40–45	452	12	11·1	6·0	0·44	0·66	726	12	7·8	5·1	0·55	0·14
45–50	262	12	8·4	3·8	0·00	0·00	564	12	9·9	3·9	1·06	0·53
50–55	267	11	7·1	4·1	0·37	0·00	351	12	5·4	8·5	1·99	0·00
55–60	637	12	3·9	4·6	0·31	0·00	394	12	9·1	6·6	3·05	1·02
60–65	650	12	7·5	4·8	1·23	0·15	948	12	7·7	8·3	2·43	0·00
65–70	262	12	8·4	5·3	0·38	0·00	1,137	12	8·7	8·1	2·11	0·00
70–75	380	12	8·2	8·2	1·58	0·00	1,393	12	7·0	11·1	1·08	0·36
75–80	316	12	5·7	6·3	1·58	0·00	1,945	12	7·2	5·6	1·70	0·21
80–85	1,482	12	3·7	5·3	1·69	0·00	573	12	6·5	5·4	2·27	0·17
85–90	304	11	2·6	6·6	0·33	0·00	1,132	12	8·2	8·9	2·30	1·06
90–95	88	9	1·1	3·4	0·00	0·00	114	10	7·0	0·0	0·63	0·00
95–100 W.	29	5	17·2	3·4	0·00	0·00	22	3	0·0	0·0	0·00	0·00
Total Obs. ...	7,087	...	409	371	61	4	11,367	...	881	792	203	31
Percentages	...	...	5·8	5·2	0·86	0·06	...	...	7·7	7·0	1·78	0·27

	Lat. 30°–35° N.						Lat. 35°–40° N.					
° °												
5–10 E.	...	...	...	...	...	...	12	2	16·7	8·3	0·00	0·00
0– 5 E.	...	...	...	...	...	...	9	1	11·1	11·1	0·00	0·00
0– 5 W.	...	...	...	...	...	...	225	10	3·6	12·0	0·00	0·89
5–10	3	1	0·0	0·0	0·00	0·00	334	11	1·8	3·3	0·00	1·80
10–15	77	10	5·2	2·6	0·00	0·00	340	12	4·4	10·9	0·29	0·29
15–20	222	11	6·3	8·5	0·40	0·00	302	12	7·0	6·6	0·00	1·66
20–25	129	9	7·0	3·9	0·78	0·00	268	11	9·0	3·7	1·12	0·00
25–30	175	10	5·1	7·4	0·00	2·29	341	11	7·3	6·2	2·05	0·00
30–35	392	12	7·9	4·3	0·51	0·00	242	12	9·5	4·1	0·00	0·00
35–40	747	12	9·2	5·7	1·87	0·00	349	12	8·9	9·5	0·29	0·29
40–45	893	12	6·7	4·4	1·46	0·45	480	12	12·8	3·8	0·63	0·21
45–50	986	12	7·5	7·3	1·12	0·00	773	12	13·2	4·0	1·55	1·68
50–55	860	12	8·3	5·7	0·93	0·47	1,100	12	12·6	4·7	2·00	0·27
55–60	723	12	12·2	6·2	2·35	0·41	1,393	12	13·5	4·5	1·72	0·57
60–65	766	12	8·0	3·7	0·91	0·13	1,797	12	11·6	4·0	2·23	0·34
65–70	1,645	12	9·8	4·0	2·67	0·00	2,974	12	9·1	4·0	2·72	6·46
70–75	2,265	12	9·8	4·0	1·85	0·31	4,193	12	12·0	5·2	1·67	3·29
75–80	1,534	12	8·9	5·9	2·67	0·20	243	12	6·2	4·9	0·41	8·64
80–85	48	6	6·4	10·4	6·25	0·00	...	...	...	...	...	...
85–90	...	...	...	...	...	...	...	...	...	...	...	...
90–95	...	...	...	...	...	...	...	...	...	...	...	...
95–100 W.	...	...	...	...	...	...	...	...	...	...	...	...
Total Obs. ...	11,465	...	1015	584	207	26	15,375	...	1642	753	265	397
·ges	...	...	8·9	5·1	1·81	0·23	...	...	10·7	4·9	1·72	2·58

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TABLE II. (*continued*). Prevalence of Rain, Calm, Thunder and Lightning, and Fog in each Square of 5° Latitude and Longitude on the NORTH ATLANTIC.

Longitude.	Lat. 40°–45° N.						Lat. 45°–50° N.					
	Total observations.	Months.	Percentage of Rain.	Calm.	Thunder and Lightn.	Fog.	Total observations.	Months.	Percentage of Rain.	Calm.	Thunder and Lightn.	Fog.
0° 0 5–10 E.	...	...	...	...	...	...	...	...	...	...	...	...
0– 5 E.	...	...	...	...	...	...	...	...	...	...	...	...
0– 5 W.	...	...	...	...	...	...	313	12	6·1	5·1	0·00	2·24
5–10	67	6	6·0	6·0	0·00	4·48	920	12	7·1	4·7	0·22	3·26
10–15	128	8	3·9	3·1	0·00	0·00	1,312	12	11·1	4·3	0·38	4·34
15–20	168	9	10·1	1·2	0·00	2·38	1,478	12	12·4	7·7	0·34	5·55
20–25	269	12	8·6	5·2	0·00	0·37	1,539	12	13·0	4·6	0·71	4·09
25–30	396	12	8·1	6·6	1·26	0·00	1,627	12	14·7	6·1	0·49	2·77
30–35	732	12	11·1	4·5	0·68	1·09	1,738	12	14·8	5·5	0·63	4·32
35–40	1,119	12	11·4	5·2	1·25	3·93	1,570	12	17·0	4·7	0.45	4·46
40–45	1,581	12	16·4	4·5	1·45	3·80	1,242	12	19·2	4·8	0·40	7·89
45–50	1,863	12	13·8	5·5	1·29	8·37	919	12	15·1	6·3	0·54	17·95
50–55	2,419	12	13·9	6·7	1·53	7·65	288	12	11·5	5·9	0·00	18·75
55–60	2,679	12	12·7	5·6	1·72	6·23	126	10	16·7	6·3	0.79	17.46
60–65	2,544	12	12·1	6·3	2·20	6·56	...	...	...	...	...	...
65–70	3,249	12	10·5	5·0	1·48	7·45	...	...	...	...	...	...
70–75	1,820	12	8·5	6·4	0·60	5·27	...	...	..	...	...	...
75–80	...	...	...	...	...	...	...	...	...	...	...	...
80–85	...	...	...	...	...	...	...	...	...	...	...	...
85–90	...	...	...	...	...	...	...	...	...	...	...	...
90–95	...	...	...	...	...	...	...	...	...	...	...	...
95–100 W.	...	...	...	...	...	...	...	...	...	...	...	...
Total Obs. ...	19,034	...	2287	1060	269	1143	13,072	...	1807	710	60	768
Percentages	...	...	12·0	5·6	1·41	6·01	...	...	13·7	5·4	0·46	5·88

	Lat. 50°–55° N.						Lat. 55°–60° N.					
0° 0 5–10 E.	...	...	...	...	...	...	...	...	...	...	...	...
0– 5 E.	...	...	...	...	...	...	...	...	...	...	...	...
0– 5 W.	583	12	11·1	5·0	0·69	3·26	30	4	16·7	10·0	0·00	0·00
5–10	1,393	12	10·3	5·6	0·39	3·37	78	9	3·8	9·0	0·00	2·56
10–15	1,260	12	11·0	4·1	0·40	4·29	117	11	19·7	1·7	0·85	4·27
15–20	932	12	17·5	3·3	0·21	4·40	123	8	8·9	0·8	0·00	4·07
20–25	850	12	15·4	4·7	0·71	4·94	102	7	7·8	2·0	0·98	0·98
25–30	694	12	16·1	5·3	0·86	7·64	60	5	15·0	10·0	0·00	10·00
30–35	510	12	10·8	3·1	0·20	4·71	...	...	...	...	...	...
35–40	420	12	19·3	1·9	0·48	4·05	...	...	...	...	...	...
40–45	150	9	23·3	0·7	0·00	6·67	...	...	...	...	...	...
45–50	...	...	...	...	...	...	...	...	...	...	...	...
50–55	...	...	...	...	...	...	...	...	...	...	...	...
55–60	...	...	...	...	...	...	...	...	...	...	...	...
60–65	...	...	...	...	...	...	...	...	...	...	...	...
65–70	...	...	...	...	...	...	...	...	...	...	...	...
70–75	...	...	...	...	...	...	...	...	...	...	...	...
75–80	...	...	...	...	...	...	...	...	...	...	...	...
80–85	...	...	...	...	...	...	...	...	...	...	...	...
85–90	...	...	...	...	...	...	...	...	...	...	...	...
90–95	...	...	...	...	...	...	...	...	...	...	...	...
95–100 W.	...	...	...	...	...	...	...	...	...	...	...	...
Total Obs....	6,792	...	923	292	30	307	510	...	59	21	2	19
Percentages	...	...	13·6	4·3	0·44	4·52	...	...	11·6	4·1	0·39	3·73

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TABLE III. Prevalence of Rain, Calm, Thunder and Lightning, and Fog in each Square of 5° of Latitude and Longitude on the NORTH PACIFIC.

Longitude.	Lat. 0°–5° N.						Lat. 5°–10° N.					
	Total observations	Months.	Percentage of				Total observations.	Months.	Percentage of			
			Rain.	Calm.	Thunder and Lightn.	Fog.			Rain.	Calm.	Thunder and Lightn.	Fog.
° °												
75– 80 W.	925	12	16·9	3·6	0·65	0·54	192	10	19·8	11·5	2·08	0·00
80– 85	3,573	12	12·1	1·5	0·22	0·39	387	10	16·0	14·2	3·36	0·00
85– 90	1,773	12	8·9	2·9	0·06	0·11	537	11	14·2	10·4	1·49	0·00
90– 95	2,694	12	7·3	8·7	0·07	0·48	216	10	14·8	7·8	1·39	0·00
95–100	864	12	8·9	2·1	0·00	0·69	366	12	22·7	5·5	1·91	0·00
100–105	906	12	12·1	3·9	0·11	0·44	891	12	19·5	7·6	2·69	0·00
105–110	999	12	10·3	5·2	0·60	0·00	1,173	12	26·7	12·4	2·98	0·00
110–115	1,362	12	6·5	4·1	0·95	0·00	1,659	12	23·4	10·5	2·17	0·00
115–120	1,404	12	8·4	0·0	0·14	0·00	1,605	12	22·1	9·8	2·55	0·19
120–125	936	12	7·2	0·9	0·11	0·00	615	12	17·9	6·7	1·30	0·00
125–130	672	12	4·8	1·2	0·00	0·00	318	11	15·4	5·3	0·31	0·00
130–135	699	11	6·1	1·6	0·00	0·00	360	11	18·6	2·5	0·00	0·00
135–140	396	10	4·0	0·8	0·25	0·00	279	11	19·4	2·5	0·72	0·00
140–145	273	10	11·4	0·0	0·00	0·00	251	11	19·9	2·0	0·00	0·00
145–150 W.	378	11	7·4	0·8	0·00	0·00	303	11	20·1	4·3	0·00	0·33
Total Obs. ...	17,854	...	1659	578	41	44	9,152	...	1921	807	192	4
Mean Percentages in 5° zones ...	...	...	9·3	3·3	0·23	0·25	...	...	21·0	8·8	1·01	0·04

Longitude.	Lat. 10°–15° N.						Lat. 15°–20° N.					
° °												
75– 80 W.	...	...	...	...	...	...	...	...	...	...	...	...
80– 85	...	...	...	...	...	...	...	...	...	...	...	...
85– 90	153	9	3·3	18·3	0·65	0·00	...	...	...	...	...	...
90– 95	333	10	4·2	18·0	0·90	0·00	30	5	16·7	6·7	0·00	0·00
95–100	438	10	8·4	12·3	2·74	0·00	219	11	4·2	19·2	0·46	0·00
100–105	531	12	7·7	9·0	2·07	0·00	708	12	3·3	13·7	0·71	0·00
105–110	741	12	22·3	11·6	5·67	0·00	561	12	10·9	7·3	2·67	0·00
110–115	1,266	12	22·3	12·4	5·28	0·08	765	12	8·6	9·3	1·70	0·13
115–120	1,719	12	17·2	12·0	3·14	0·06	1,200	12	8·7	8·1	0·58	0·25
120–125	927	12	14·0	8·3	1·73	0·00	1,398	12	5·1	3·4	1·00	0·21
125–130	264	11	12·5	3·0	0·00	0·00	867	12	5·3	3·2	0·35	0·69
130–135	237	11	8·9	0·4	1·69	0·00	249	12	6·0	2·0	2·41	0·00
135–140	276	10	6·2	1·4	0·00	0·00	222	10	5·0	1·8	0·45	0·00
140–145	213	9	10·8	0·5	0·00	0·00	368	12	9·8	0·8	0·00	0·00
145–150 W.	213	11	9·4	2·8	0·00	0·00	534	12	8·1	2·1	0·94	0·00
Total Obs. ...	7,311	...	1085	737	210	2	7,121	...	492	449	70	13
Mean Percentages in 5° zones ...	...	...	14·8	10·1	2·87	0·03	...	...	6·9	6·3	0·98	0·18

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TABLE III. (*continued*). Prevalence of Rain, Calm, Thunder and Lightning, and Fog in each Square of 5° Latitude and Longitude on the NORTH PACIFIC.

Longitude.	Lat. 20°-25° N.						Lat. 25°-30° N.					
	Total observations.	Months.	Percentage of				Total observations.	Months.	Percentage of			
			Rain.	Calm.	Thunder and Lightn.	Fog.			Rain.	Calm.	Thunder and Lightn.	Fog.
75°- 80° W.	...	...	...	...	...	...	...	...	...	...	...	...
80- 85	...	...	...	...	...	...	...	...	...	...	...	...
85- 90	...	...	...	...	...	...	...	...	...	...	...	...
90- 95	...	...	...	...	...	...	...	...	...	...	...	...
95-100	...	...	...	...	...	...	...	...	...	...	...	...
100-105	...	...	...	...	...	...	...	...	...	...	...	...
105-110	775	12	2·2	9·5	2·97	0·00	...	...	...	...	...	...
110-115	837	12	2·9	6·9	0·24	0·36	192	11	1·0	2·1	0·00	1·56
115-120	856	12	3·0	4·1	0·58	2·10	690	12	1·9	3·6	0·14	2·03
120-125	1,108	12	2·9	4·9	0·36	3·25	1,074	12	2·5	8·6	0·00	4·28
125-130	1,398	12	3·0	7·2	0·00	1·07	1,386	12	5·8	9·9	0·22	3·32
130-135	783	12	4·5	4·5	0·00	0·13	2,088	12	5·1	9·3	0·05	0·86
135-140	285	12	6·7	4·6	0·35	0·00	1,016	12	4·7	7·4	0·19	1·18
140-145	435	12	7·6	1·6	0·00	0·69	645	12	12·1	4·0	0·62	0·31
145-150 W.	621	12	7·2	2·9	1·11	0·00	558	12	9·5	4·1	0·54	0·18
Total Obs. ...	7,098	...	273	395	42	76	7,649	...	409	577	14	142
Mean Percentages in 5° zones ...	...	...	3·8	5·6	0·59	1·07	...	...	5·3	7·5	0·18	1·86

	Lat. 30°-35° N.						Lat. 35°-40° N.					
75°- 80° W.	...	...	...	...	...	...	...	...	...	...	...	...
80- 85	...	...	...	...	...	...	...	...	...	...	...	...
85- 90	...	...	...	...	...	...	...	...	...	...	...	...
90- 95	...	...	...	...	...	...	...	...	...	...	...	...
95-100	...	...	...	...	...	...	...	...	...	...	...	...
100-105	...	...	...	...	...	...	...	...	...	...	...	...
105-110	...	...	...	...	...	...	...	...	...	...	...	...
110-115	...	...	...	...	...	...	...	...	...	...	...	...
115-120	333	12	2·7	9·0	0·30	6·31	...	...	...	...	...	...
120-125	1,260	12	2·6	7·6	0·08	7·22	2,256	12	5·1	8·7	0·00	18·09
125-130	2,256	12	5·7	8·7	0·62	5·67	1,827	12	6·6	5·9	0·49	9·85
130-135	2,442	12	5·2	8·7	0·08	3·15	1,108	12	4·2	6·4	0·18	3·52
135-140	1,467	12	5·9	10·1	0·07	2·38	1,071	12	5·3	7·6	0·09	3·91
140-145	732	12	7·2	6·8	0·27	0·14	510	11	7·8	6·9	0·20	1·37
145-150 W.	426	11	6·8	4·0	0.00	0·00	543	11	8·7	4·8	0·00	1·84
Total Obs. ...	8,916	...	464	749	21	353	7,315	...	427	517	13	686
Mean Percentages in 5° zones ...	...	...	5·2	8·4	0·24	3·96	...	...	5·8	7·1	0·18	9·38

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TABLE III. (*continued*). Prevalence of Rain, Calm, Thunder and Lightning, and Fog in each Square of 5° Latitude and Longitude on the NORTH PACIFIC.

Longitude.	Lat. 40°–45° N.						Lat. 45°–50° N.					
	Total observations.	Months.	Percentage of				Total observations.	Months.	Percentage of			
			Rain.	Calm.	Thunder and Lightn.	Fog.			Rain.	Calm.	Thunder and Lightn.	Fog.
° ° 75– 80 W.	...	...	...	...	...	...	...	...	...	...	...	...
80– 85	...	...	...	...	...	...	...	...	...	...	...	...
85– 90	...	...	...	...	...	...	...	...	...	...	...	...
90– 95	...	...	...	...	...	...	...	...	...	...	...	...
95–100	...	...	...	...	...	...	...	...	...	...	...	...
100–105	...	..	...	...	...	...	...	...	...	...	...	...
105–110	...	...	...	...	...	...	...	...	...	...	...	...
110–115	...	...	...	...	...	...	...	...	...	...	...	...
115–120	...	...	...	...	...	...	...	...	...	...	...	...
120–125	15	2	13·3	0·0	0·00	13·33	18	3	44·4	5·6	0·00	0·0c
125–130	147	9	8·8	4·1	0·00	6·8c	123	6	16·3	1·6	0·81	15·45
130–135	213	10	14·1	3·8	0·47	4·69	84	6	6·0	0·0	0·00	26·19
135–140	198	9	9·1	3·5	0·00	2·02	182	7	8·2	3·3	0·00	7·69
140–145	312	10	10·9	2·6	0·00	3·21	189	7	7·4	2·1	0·00	13·23
145–150 W.	315	10	8·6	3·2	0·00	6·35	402	7	6·7	3·7	0·00	18·41
Total Obs. ...	1,200	...	123	39	1	56	998*	...	89	28	1	154
Mean Percentages in 5° zones ...	...	...	10·3	3·3	0·08	4·67	...	...	8·9	2·8	0·11	15·43

	Lat. 50°–55° N.						Lat. 55°–60° N.					
° ° 75– 80 W.	...	...	...	...	...	...	...	...	...	...	...	...
80– 85	...	...	...	...	...	...	...	...	...	...	...	...
85– 90	...	...	...	...	...	...	...	...	...	...	...	...
90– 95	...	...	...	...	...	...	...	...	...	...	...	...
95–100	...	...	...	...	...	...	...	...	...	...	...	...
100–105	...	...	...	...	...	...	...	...	...	...	...	...
105–110	...	...	...	...	...	...	...	...	...	...	...	...
110–115	...	...	...	...	...	...	...	...	...	...	...	...
115–120	...	...	...	...	...	...	...	...	...	...	...	...
120–125	...	...	...	...	...	...	...	...	...	...	...	...
125–130	6	1	0·0	0·0	0·00	0·00	...	...	...	...	...	...
130–135	294	5	10·9	2·7	0·00	19·73	24	2	12·5	4·3	0·c0	0·00
135–140	987	7	7·3	5·3	0·c0	19·76	579	7	13·3	6·1	0·00	20·55
140–145	1,335	6	7·7	3·7	0·00	14·31	2,028	5	9·4	4·6	0·00	14·89
145–150 W.	2,616	6	8·5	3·8	0·00	14·18	1,785	6	10·4	3·9	0·00	16·41
Total Obs. ...	5,238*	...	435	208	...	815	4,416*	...	456	198	...	711
Mean Percentages in 5° zones ...	...	...	8·3	4·0	0·00	15·56	...	...	10·3	4·5	0·00	16·10

* The observations between lat. 45° and 60° N. are almost all in the summer months.

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EDITED BY

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1868, MARCH 18.

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Vol. IV. 1868, MARCH 18. [No. 36.

JAMES GLAISHER, Esq., F.R.S. &c., President, in the Chair.

The names of three Candidates for admission into the Society were read.

XIII. *On the Fall of Rain at the different Hours of the Day, in the several Months and Seasons of the Year.* By James Glaisher, Esq., F.R.S. &c.

At the Meeting of this Society in January I read a paper on "the Frequency of Rain at the different Hours of the Day, in the several Months and Seasons of the Year." In the paper I am now about to read, the fall of rain in every corresponding hour, and every corresponding period to those in that paper are given, and in addition, in some of the principal divisions, the average fall of rain on the ground per period, as found by dividing the amounts in this paper by the corresponding frequency per period given in the former paper, and increasing the quotients in the ratio of 6:10, as was found necessary in the paper in the November Number of the Proceedings.

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TABLE I. Amounts of Rainfall during every Hour in every above the

JANUARY.

Years.	Between 0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1861	·001	·014	·012	·003	·002	·003	·004	·003	·005	·004	·005	·002
1862	·008	·021	·095	·082	·035	·037	·023	·033	·025	·013	·000	·000
1863	·006	·002	·004	·001	·003	·017	·093	·083	·043	·042	·041	·045
1864	·001	·031	·001	·001	·001	·001	·001	·011	·007	·030	·005	·029
1865	·053	·002	·025	·091	·037	·025	·059	·055	·038	·082	·121	·214
1866	·042	·035	·044	·044	·012	·040	·041	·007	·012	·002	·001	·029

The largest amount of rain which fell during any hour was 0·287 in., between same year, and the third heaviest amount which fell being 0·179 in., between

FEBRUARY.

1861	·019	·019	·085	·041	·007	·050	·000	·003	·039	·046	·037	·030
1862	·018	·012	·007	·006	·024	·020	·040	·018	·000	·000	·000	·000
1863	·005	·007	·020	·011	·005	·000	·000	·000	·003	·000	·000	·000
1864	·046	·004	·003	·003	·000	·006	·003	·002	·001	·000	·000	·000
1865	·118	·082	·028	·010	·004	·017	·056	·000	·050	·035	·000	·055
1866	·074	·155	·202	·021	·010	·025	·036	·049	·029	·090	·248	·153

The largest amount of rain which fell during any hour was 0·248 in., between and 3h in the same year; the third largest, amounting to 0·180 in., fell between

MARCH.

1861	·167	·054	·055	·070	·085	·094	·032	·037	·012	·007	·001	·011
1862	·227	·090	·120	·094	·070	·081	·023	·020	·077	·110	·110	·235
1863	·000	·023	·013	·120	·043	·025	·055	·047	·038	·036	·040	·016
1864	·045	·035	·019	·012	·040	·006	·028	·008	·073	·109	·090	·118
1865	·000	·000	·020	·021	·006	·007	·000	·000	·000	·003	·005	·010
1866	·007	·028	·022	·001	·025	·023	·030	·020	·045	·126	·085	·068

The largest amount of rain which fell during any hour was 0·235 in., between and 1h in the same year; the third largest, amounting to 0·167 in., fell between

APRIL.

1861	·097	·046	·030	·020	·006	·024	·006	·030	·003	·000	·000	·000
1862	·034	·020	·022	·035	·023	·020	·010	·071	·012	·104	·110	·039
1863	·006	·020	·073	·022	·031	·007	·003	·003	·000	·000	·000	·000
1864	·040	·005	·010	·016	·030	·042	·021	·031	·004	·003	·000	·006
1865	·000	·087	·040	·000	·000	·000	·000	·000	·000	·000	·000	·000
1866	·070	·065	·151	·358	·315	·017	·058	·024	·030	·045	·056	·017

The largest amount of rain which fell during any hour in April was 0·358 in., the following hour of the same year, the third largest being 0·188 in., which

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Month in the Years 1861–66, at the height of 50 feet ground.

JANUARY.

what Hours.												
12^h to 13^h.	13^h to 14^h.	14^h to 15^h.	15^h to 16^h.	16^h to 17^h.	17^h to 18^h.	18^h to 19^h.	19^h to 20^h.	20^h to 21^h.	21^h to 22^h.	22^h to 23^h.	23^h to 24^h.	Years.
in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
·002	·010	·012	·010	·000	·001	·000	·001	·012	·000	·000	·001	1861.
·008	·000	·015	·071	·036	·043	·084	·179	·120	·093	·013	·009	1862.
·030	·022	·006	·061	·105	·074	·141	·176	·125	·014	·043	·004	1863.
·030	·006	·006	·028	·016	·017	·030	·028	·064	·085	·063	·005	1864.
·287	·155	·111	·019	·045	·036	·038	·032	·062	·095	·022	·030	1865.
·114	·104	·071	·026	·018	·029	·070	·067	·045	·151	·092	·057	1866.

12^h and 13^h in 1865,—the next in order being 0·214 in., between 11^h and 12^h in the 19^h and 20^h in 1862.

FEBRUARY.

·020	·006	·026	·033	·115	·073	·047	·038	·147	·083	·045	·026	1861.
·000	·000	·000	·000	·008	·020	·010	·024	·025	·006	·005	·023	1862.
·000	·015	·013	·012	·031	·114	·070	·032	·025	·018	·013	·000	1863.
·015	·003	·000	·000	·000	·018	·028	·030	·036	·063	·010	·026	1864.
·057	·059	·016	·014	·010	·011	·003	·010	·022	·034	·028	·053	1865.
·180	·010	·062	·055	·024	·019	·145	·072	·112	·137	·081	·022	1866.

the hours of 10 and 11 in 1866,—the next in order being 0·202 in. between 2^h 12^h and 13^h, also in 1866.

MARCH.

·018	·026	·067	·030	·038	·072	·130	·068	·042	·047	·000	·054	1861.
·112	·046	·111	·081	·022	·081	·095	·063	·049	·023	·066	·079	1862.
·003	·000	·000	·000	·005	·000	·000	·000	·004	·000	·000	·000	1863.
·091	·045	·044	·026	·095	·069	·087	·105	·083	·026	·032	·037	1864.
·030	·030	·022	·014	·021	·014	·019	·022	·023	·010	·000	·000	1865.
·046	·029	·051	·032	·017	·010	·005	·074	·040	·045	·063	·000	1866.

the hours of 11 and 12 in 1862,—the next in order being 0·227 in. between 0^h 0 and 1 hours of 1861.

APRIL.

·001	·006	·004	·000	·069	·060	·015	·015	·020	·040	082	·120	1861.
·112	·055	·080	·128	·164	·188	·174	·122	·093	·025	·004	·008	1862.
·002	·020	·008	·004	·000	·000	·000	·000	·000	·000	·000	·005	1863.
·007	·033	·050	·043	·037	·033	·003	·020	·028	·000	·035	·048	1864.
·000	·000	·094	·012	·000	·000	·000	·000	·000	·000	·000	·000	1865.
·051	·010	·014	·002	·000	·020	·009	·014	·008	·010	·000	·036	1866.

between 3 and 4 hours in 1866,—the next in order amounting to 0·315 in., in fell between the hours 17 and 18 in 1862.

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TABLE I. Amounts of Rainfall during every Hour in every above the

MAY.

Years.	Between											
	0^h to 1^h.	1^h to 2^h.	2^h to 3^h.	3^h to 4^h.	4^h to 5^h.	5^h to 6^h.	6^h to 7^h.	7^h to 8^h.	8^h to 9^h.	9^h to 10^h.	10^h to 11^h.	11^h to 12^h.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1861	·009	·002	·001	·009	0·002	·000	·020	·283	·051	·000	·000	·046
1862	·096	·214	·047	·030	0·033	·105	·077	·103	·083	·028	·024	·094
1863	·009	·000	·000	·000	0·072	·074	·025	·012	·000	·004	·030	·018
1864	·020	·041	·096	·081	0·035	·040	·039	·028	·008	·038	·068	·108
1865	·076	·070	·001	·201	1·020	·025	·055	·005	·020	·035	·002	·000
1866	·005	·002	·005	·000	0·040	·005	·012	·000	·062	·013	·145	·143

The largest amount of rain which fell during any hour in May was 1·020 in., occurring between 14 and 15 hours in 1866, and the third, 0·450 in., between

JUNE.

1861	·123	·147	·060	·080	·111	098	·015	·096	·038	·010	·006	·000
1862	·148	·043	·098	·098	·096	·142	·118	·191	·045	·084	·031	·046
1863	·042	·043	·108	·120	·040	·084	·031	·052	·217	·038	·146	·060
1864	·068	·062	·036	·038	·035	·014	·005	·010	·047	·013	·005	·005
1865	·000	·430	·115	·010	·002	·090	·076	·173	·231	·221	·052	·078
1866	·020	·050	·041	·014	020	·000	·057	·231	·123	·290	·364	·175

The largest amount of rain which fell during any hour in June was 0·454 in., fell between 1 and 2 hours in 1865; and the third largest, 0·364 in., between

JULY.

1861	·000	·148	·148	·128	·022	·024	·014	·009	·008	·202	·245	·241
1862	·082	·082	·037	·027	·162	·025	·059	·151	·045	·014	·006	·012
1863	·000	·016	·009	·022	·044	·047	·110	·088	·070	·004	·000	·000
1864	·025	·002	·001	·001	·001	·001	·001	·000	·000	·005	·037	·001
1865	·015	·080	·000	·025	·144	·146	·199	·169	·111	·060	·061	·091
1866	·008	·024	·067	·000	·000	·000	·016	·000	·021	·063	·015	·010

The largest amount of rain which fell during any hour in July was 0·509 in., 0·245 in., between 10 and 11 hours in 1861, the third largest (0·241 in.) being in

AUGUST.

1861	·038	·004	·001	·002	·039	·002	·000	·000	·000	·000	·010	·002
1862	·062	·124	·161	·185	·046	·023	·006	·056	·044	·071	·061	·020
1863	·004	·007	·049	·098	·266	·058	·041	·031	·082	·151	·150	·003
1864	·072	·029	·101	·014	·002	·000	·000	·000	·000	·000	·000	·000
1865	·140	·082	·130	·400	·376	·394	·052	·020	·137	·302	·035	·020
1866	·209	·047	·047	·027	·053	·030	·000	·000	·000	·001	·001	·071

The largest amount of rain which fell in any hour during this month was tween 5 and 6 hours of the same year, the third largest (amounting to 0·376 in.)

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Month in the Years 1861–66, at the height of 50 feet ground (*continued*).

MAY.

what Hours.												
12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	Years.
in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
·055	·076	·005	·009	·020	·008	·089	·140	·070	·157	·034	·003	1861.
·085	·055	·043	·199	·060	·108	·162	·050	·012	·014	·091	·069	1862.
·009	·030	·034	·011	·056	·053	·014	·053	·020	·011	·026	·010	1863.
·104	·236	·102	·197	·006	·010	·032	·027	·018	·043	·010	·020	1864.
·025	·062	044	·450	·117	·268	·174	·448	·166	·045	·072	·025	1865.
·278	·282	·453	·170	·062	·011	·012	·024	·040	·041	·018	·018	1866.

between 4 and 5 hours in 1865,—the next in order amounting to 0·453 in., the following hours of 1865.

JUNE.

·000	·000	·000	·018	·015	·045	·054	·004	·032	·134	·030	·023	1861.
·040	·003	·000	·013	·009	·016	·002	·000	·003	·020	·037	·054	1862.
·085	·121	·065	·141	·289	·454	·271	·078	·310	·072	·003	·008	1863.
·020	·020	·020	·012	·027	·043	·017	·022	·026	·025	·006	·004	1864.
·140	·080	·102	·090	·082	·000	·000	·000	·000	·000	·000	·000	1865.
·210	·087	·053	·225	·248	·045	·000	·003	·027	·160	·042	·003	1866.

between 17 and 18 hours in 1863; the next in order, amounting to 0·430 in., the hours of 10 and 11 in 1866.

JULY.

·042	·119	·033	·020	·076	·011	·000	·000	·043	·008	·063	·034	1861.
·005	·038	·147	·106	·053	·048	·013	·006	·003	·008	·003	·014	1862.
·000	·000	·000	·000	·000	·000	·025	·072	·013	·000	·000	·120	1863.
·001	·002	·000	000	·000	·021	·048	·026	·004	·001	·000	·000	1864.
·042	·017	·019	·509	·083	·037	·040	·012	·001	·000	·003	·010	1865.
·000	·000	·014	·057	·100	·000	·000	·000	·000	·000	·000	·130	1866.

between the hours of 15 and 16 in the year 1865,—the next in order being the following hour of the same year.

AUGUST.

·000	·000	·000	·000	·000	·025	·009	·000	·000	·014	·066	·112	1861.
·013	·020	·233	·202	·125	·054	·023	·087	·103	·024	·010	·024	1862.
·000	·000	·010	·004	·030	·049	·080	·052	·006	·013	·005	·002	1863.
·010	·007	·004	·035	·023	·035	·015	·004	·010	·018	·071	·037	1864.
·051	·077	·005	·000	·005	·148	·138	·078	·106	·065	·110	·154	1865.
·061	·026	·018	·026	·053	·057	·023	·068	·041	·002	·014	·055	1866.

0·400 in., between 3 and 4 hours in 1865,—the next in order being 0·394 in., befalling between 4 and 5 hours, also in 1865.

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TABLE I. Amounts of Rainfall during every Hour in every above the

SEPTEMBER.

Years.	Between 0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1861	·017	·103	·040	·086	·227	·027	·097	·067	·010	·000	·009	·035
1862	·010	·068	·096	·040	·033	·032	·025	·070	·078	·083	·048	·101
1863	·051	·036	·087	·060	·075	·018	·042	·045	·035	·043	·145	·263
1864	·010	·003	·003	·011	·032	·092	·022	·039	·017	·050	·064	·114
1865	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000	·000
1866	·029	·117	·057	·090	·197	·062	·072	·026	·094	·104	·016	·017

The largest amount of rain which fell in any hour during this month was between 13 and 14 hours of 1863, the third largest (amounting to 0·336 in.)

OCTOBER.

1861	·004	·009	·211	·092	·012	·007	·000	·002	·065	·021	·002	·000
1862	·081	·099	·233	·317	·124	·044	·149	·056	·063	·110	·121	·079
1863	·016	·103	·155	·096	·035	·048	·024	·000	·000	·000	·010	·008
1864	·000	·000	·000	·000	·000	·011	·000	·000	·015	·020	·032	·055
1865	·066	·030	·189	·135	·130	·220	·143	·092	·048	·210	·114	·120
1866	·172	·097	·076	·021	·061	·056	·041	·026	·087	·099	·040	·003

The largest amount of rain which fell in any hour during October was tween 19 and 20 hours in the same year, the third largest (0·233 in.) between

NOVEMBER.

1861	·246	·380	337	·262	·205	·181	·089	·069	·078	·019	·014	·034
1862	·084	·027	·022	·020	·066	·048	·010	·011	·005	·000	·000	·000
1863	·056	·012	·002	·000	·017	·072	·002	·003	003	·006	·003	·004
1864	·002	·002	·002	·002	·053	·019	·137	·110	·196	·114	·070	·055
1865	·000	·000	·005	·112	·032	·060	·066	·010	·034	·029	·000	·010
1866	·028	·030	·006	·005	·022	·021	·003	·057	·000	·056	·060	·052

The largest amount of rain which fell in any hour during this month was tween 2 and 3 hours in the same year, the third largest being 0·262 in., which

DECEMBER.

1861	·002	·023	·056	·076	·038	·031	·001	·000	·000	·010	·004	·034
1862	·041	·031	·064	·046	·079	·002	·041	·034	·020	·008	·002	031
1863	·000	·008	·098	·021	·002	·002	·000	·004	·013	·026	·016	·018
1864	·007	·014	014	·003	·008	·035	·008	·013	·012	·000	·000	·000
1865	·005	·000	·010	·000	·000	·010	·005	·012	·020	·023	·038	·012
1866	·027	·057	·110	·002	·002	·006	·009	·018	·056	·066	·041	·052

The largest amount of rain which fell in any hour during this month was between 17 and 18 hours in 1863; the third largest, amounting to 0·110 in., fell

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Month in the Years 1861–66, at the height of 50 feet ground (*continued*).

SEPTEMBER.

what Hours.												
12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	Years.
in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
·055	·083	·060	·023	·009	·038	·013	·005	·000	·020	·000	·017	1861.
·114	·009	·001	·015	·044	·037	·120	·188	·067	·043	·002	·001	1862.
·221	·343	·214	·107	·049	·048	·008	·054	·069	·077	·072	·088	1863.
·111	·336	·080	·219	·454	·046	·004	·071	·040	·203	·069	·011	1864.
·000	·000	·000	·000	·016	·016	·036	·012	·001	·005	·000	·000	1865.
·035	·032	·128	·257	·126	·166	·123	·219	·030	·089	·052	·039	1866.

0·454 in., between 16 and 17 hours in 1864,—the next in order being 0·343 in., falling between the same hours of the following year.

OCTOBER.

·041	·083	·010	·015	·010	·021	·011	·004	·018	·023	·000	·113	1861.
·023	·008	·012	·125	·117	·054	·113	·288	·182	·139	·010	·165	1862.
·012	·063	·105	·016	·028	·012	·011	·009	·014	·051	·024	·021	1863.
·049	·072	·040	·004	·057	·198	·140	·000	·044	·005	·000	·000	1864.
·084	·037	·020	·010	·160	·193	·092	·105	·103	·233	·000	·040	1865.
·001	·000	·090	·092	·229	·146	·070	·082	·066	·102	·024	·087	1866.

0·317 in., between 3 and 4 hours in 1862,—the next in order being 0·288 in., between 2 and 3 hours of 1862, and also between 21 and 22 hours in 1865.

NOVEMBER.

·007	·051	·060	·083	·077	·152	·150	·084	·068	·079	·120	·166	1861.
·018	·016	·019	·015	·035	·078	·035	·050	·025	·050	·034	·023	1862.
·022	·046	·047	·042	·030	·000	·070	·160	·069	·069	·056	·102	1863.
·157	·140	·113	·058	·108	·069	·010	·000	·035	·065	·000	·005	1864.
·069	·029	·030	·020	·010	·015	·007	·013	·014	·052	·031	·083	1865.
·040	·090	·042	·057	·047	·034	·004	·000	·000	·070	·030	·020	1866.

0·380 in., between 1 and 2 hours in 1861,—the next in order being 0·337 in., befell during the following hour also of 1861.

DECEMBER.

·161	·105	·056	·101	·030	·060	·050	·025	·008	·003	·000	·004	1861.
·092	·068	·052	·102	·031	·002	·006	·008	·002	·022	·049	·103	1862.
·003	·000	·000	·040	·029	·145	·055	·063	·024	·005	·000	·000	1863.
·000	·003	·000	·047	·004	·000	·000	·000	·003	·017	·009	·045	1864.
·023	·020	·018	·014	·019	·009	·006	·022	·002	·000	·004	·000	1865.
·065	·049	·028	·025	·020	·039	·011	·046	·042	·063	·034	·033	1866.

0·161 in., between 12 and 13 hours in 1861,—the next in order being 0·145 in., between the hours of 2 and 3 in 1866.

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TABLE II. Showing the Total amounts of Rain which fell, at the height of 50 feet above the ground, in every Hour of each Month in the Six Years (1861–66), and the average fall per Hour in each Month.

Month.	Between what Hours.																							Average Fall of Rain per Hour.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Jan....	·111	·075	·181	·222	·090	·123	·221	·192	·130	·173	·173	·319	·471	·297	·221	·215	·220	·200	·363	·483	·428	·438	·233	·106	0·237
Feb....	·280	·279	·345	·092	·050	·118	·135	·072	·122	·171	·285	·238	·272	·093	·117	·114	·188	·255	·303	·206	·367	·341	·182	·150	0·199
March	·446	·230	·249	·318	·269	·236	·168	·132	·245	·391	·331	·458	·300	·176	·295	·183	·198	·246	·336	·332	·241	·151	·161	·170	0·261
April.	·247	·243	·326	·451	·405	·110	·098	·159	·049	·152	·166	·062	·173	·124	·250	·189	·270	·301	·201	·171	·149	·075	·121	·217	0·196
May..	·215	·329	·150	·321	1·202	·249	·228	·431	·224	·118	·269	·409	·556	·741	·681	1·036	·321	·458	·483	·742	·326	·311	·251	·145	0·425
June..	·401	·775	·458	·360	·304	·428	·302	·753	·701	·656	·604	·364	·495	·311	·240	·499	·670	·603	·344	·107	·398	·411	·118	·092	0·433
July ..	·130	·352	·262	·203	·373	·243	·399	·417	·255	·348	·364	·355	·090	·176	·213	·692	·312	·117	·126	·116	·064	·017	·069	·308	0·250
Aug...	·525	·293	·489	·726	·782	·507	·099	·107	·263	·525	·257	·116	·135	·130	·270	·267	·236	·368	·288	·289	·266	·136	·276	·384	0·322
Sept...	·117	·327	·283	·287	·564	·231	·258	·247	·234	·280	·282	·530	·536	·803	·483	·621	·698	·351	·304	·549	·207	·437	·195	·156	0·371
Oct...	·339	·338	·864	·661	·362	·386	·357	·176	·278	·460	·319	·265	·210	·263	·277	·262	·601	·624	·437	·488	·427	·553	·058	·426	0·393
Nov...	·416	·451	·374	·401	·395	·401	·307	·260	·316	·224	·147	·155	·313	·372	·311	·275	·307	·348	·276	·307	·211	·385	·271	·399	0·313
Dec...	·082	·133	·352	·148	·129	·086	·064	·081	·121	·133	·101	·147	·344	·245	·154	·329	·133	·255	·128	·164	·081	·110	·096	·185	0·158

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From the numbers in this Table, the largest falls of rain in any hour, in the different months, at the height of 50 feet above the ground, are as follows:—

		h		h				in.
In January ...	from	19	to	20	..... and the amount was			0·483
February	„	20	„	21	.....	„	„	0·367
March.....	„	11	„	12	.....	„	„	0·458
April	„	3	„	4	.....	„	„	0·451
May.....	„	4	„	5	.....	„	„	1·202
June	„	1	„	2	.....	„	„	0·775
July.....	„	15	„	16	.....	„	„	0·692
August ...	„	4	„	5	.....	„	„	0·782
September	„	13	„	14	.....	„	„	0·803
October	„	2	„	3	.....	„	„	0·864
November	„	1	„	2	.....	„	„	0·451
December	„	2	„	3	.....	„	„	0·352

From these numbers it seems that the heaviest fall took place in May, between the hours of 4 P.M. and 5 P.M.; and by reference to Table II. it will be seen that in the same month, between 3 A.M. and 4 A.M., a second large fall amounting to 1·036 in. took place.

The smallest falls of rain in any hour, at the height of 50 feet above the ground, in the different months, are as follows:—

		h		h				in.
In January ...	from	1	to	2	..... and the amount was			0·075
February	„	4	„	5	.....	„	„	0·050
March.....	„	7	„	8	.....	„	„	0·132
April	„	8	„	9	.....	„	„	0·049
May.....	„	9	„	10	.....	„	„	0·118
June	„	23	„	24	.....	„	„	0·092
July	„	21	„	22	.....	„	„	0·017
August ...	„	6	„	7	.....	„	„	0·099
September	„	0	„	1	.....	„	„	0·117
October ...	„	22	„	23	.....	„	„	0·058
November	„	10	„	11	.....	„	„	0·147
December	„	6	„	7	.....	„	„	0·064

The smallest fall of rain in any hour in the year was 0·017 in., in the month of July, between the hours of 9 A.M. and 10 A.M.; and the next in order was in the hour between 8 P.M. and 9 P.M., in April.

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In *January*, the three consecutive hours of largest falls were from 7 A.M. to 10 A.M., their sum is 1·349 in.; and those of the least from noon to 3 P.M., amounting to 0·367 in. The fall of rain was below the average in every hour from 10 A.M. to 11 P.M., was above from 11 P.M. to 2 A.M., then below for four hours, and above from 6 A.M. to 10 A.M.

In *February*, the three hours of consecutive largest falls were from 7 A.M. to 10 A.M., their amount is 0·914 in.; and those of the least from 3 P.M. to 6 P.M., their amount is 0·260 in. The fall of rain in each hour was above the average hourly fall for the month from noon to 3 P.M., was below it from 3 P.M. to 10 P.M., above from 10 P.M. to 1 A.M., then below till 5 A.M., above till 10 A.M., and below in the two hours preceding noon.

In *March*, the three hours of consecutive greatest falls were from 9 P.M. to midnight, their amount is 1·180 in.; and those of the least from 9 A.M. to noon, their amount is 0·482 in. The falls per hour were below the average from 8 A.M. to 9 P.M., with the exception of 0^h to 1^h P.M. and 3^h to 5^h P.M.; and they were above generally from 9 P.M. to 8 A.M., the exceptions being 1 A.M. to 2 A.M., and 3 A.M. to 6 A.M.

In *April*, the three consecutive hours of greatest falls were from 2 P.M. to 5 P.M., their amount is 1·182 in.; and those of the least from 6 P.M. to 9 P.M., their amount is 0·306 in. The falls per hour were greater than the monthly hourly falls from 11 A.M. to 5 P.M., and less from 5 P.M. to 11 A.M., with the exception of 2 A.M. to 3 A.M. and 4 A.M. to 7 A.M.

In *May*, the three consecutive largest falls were from 1 A.M. to 4 A.M.; their amount is 2·458 in., and is distinguished by being the largest in the year; the three hours of the least falls were from 8 P.M. to 11 P.M., and their amount is 0·611 in. The hourly falls of rain were less than the average from 4 A.M. to midnight generally; the exceptions were from 5 A.M. to 8 A.M., the heavy fall of 1·202 in. between 4 and 5 P.M., and one hour with a slight excess, viz. 7 to 8 P.M.; and they were greater than the average from midnight to 4 A.M.

In *June*, the three hours of consecutive largest falls were from 7 P.M. to 10 P.M., and those of the least in the three hours preceding noon; and the amounts were 2·110 in. and 0·621 in. respectively. The hourly falls were less than the average from 6 A.M. to 1 P.M., were greater from 1 P.M. to 3 P.M., were again less from 3 P.M. to 7 P.M., were greater to 11 P.M., were less till 3 A.M.,

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with the exception of the hour following midnight, and were greater from 3 A.M. to 6 A.M.

In *July*, the three hours of consecutive largest falls were in the morning, from 2^h to 5^h; and of the least, also in the morning, from 8^h to 11^h; their amounts were respectively 1·217 in. and 0·150 in. The hourly falls were less than the average from 5 A.M. to 11 A.M.; they were almost alternately in excess and defect from 11 A.M. to 6 P.M., were then greater than the average from 6 P.M. to midnight, were less from midnight to 3 A.M., and greater till 5 A.M.

In *August*, the fall of rain in the three hours from 3 P.M. to 6 P.M. was 2·015 in., being the largest; and the smallest was 0·381 in., in the three hours ending at 2 A.M. Rain fell above the hourly average in every hour from 11 A.M. to 6 P.M., excepting the hour from 1 P.M. to 2 P.M., and was below the average at all other hours, excepting 9 P.M. to 10 P.M. and 5 A.M. to 6 A.M.

In *September*, the rain in the three hours from 1 A.M. to 4 A.M. was 1·907 in., and from noon to 3 P.M. was 0·727 in.; and these are the largest and smallest falls respectively in the month. With the exception of the hours from 7 A.M. to 8 A.M., 9 A.M. to 10 A.M., and 4 P.M. to 5 P.M., the hourly falls of rain were *below* the average from 5 A.M. to 11 P.M., and were greater than the average in every hour from 11 P.M. to 5 A.M.

In *October*, the amounts of 1·887 in., which fell in the hours from 2 P.M. to 5 P.M., and 0·738 in., which fell between 11 P.M. and 2 A.M., are the greatest and least falls, respectively, in any consecutive three hours in the month. The hourly falls of rain were the greatest and above the average from 4 A.M. to 4 P.M., with the exception of 10 A.M. to 11 A.M. and noon to 2 P.M.; and they were below the average from 4 P.M. to 4 A.M., with the exception of 9 P.M. to 10 P.M.

In *November*, the three hours of heaviest consecutive rainfall were from noon to 3 P.M., the amount was 1·241 in.; and those of the least were from 9 P.M. to midnight, the amount was 0·526 in. With the exception of the hour from 10 A.M. to 11 A.M., the hourly rain was in excess of its average from 9 A.M. to 6 P.M., and, with two or three trifling exceptions, was in defect from 6 P.M. to 8 A.M.

In *December*, the amount of rain in the three hours following midnight is 0·743 in., being the greatest, and from 5 P.M. to 8 P.M. 0·231 in., being the least in amount, of any consecutive three hours in the month, and the smallest of any three consecutive hours in

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the year. The hours of excess and defect above the average are more intermixed than in any other month; the longest period of uniformity is from 3 P.M. to midnight: during every hour of this group, the fall was less than the average; it was in excess in the two hours following midnight, then almost alternately in defect and excess through the remainder of the day, or from 2 A.M. to 3 P.M.

From these particulars of each month it may be gathered that the periods of highest and heaviest falls are different in different seasons of the year.

The least rain in periods, falls:—

In January, from 10 A.M. to midnight nearly.

February, during the early afternoon hours to 10 P.M., and again in the early morning hours.

March, during the four hours preceding noon, and the early afternoon hours.

April, during the evening hours from 5 P.M., extending to the early morning hours.

May, during the four hours preceding noon, and extending to midnight.

June, during the six hours preceding noon, and generally to 7 P.M.

July, from 5 A.M. generally to 6 P.M.

August, from 6 P.M. generally to 11 A.M.

September, from two hours preceding noon to 11 P.M.

October, from 4 P.M. to 4 A.M., with the exception of the hour from 9^h to 10^h.

November, from 7 P.M. to 9 A.M., with one or two exceptions.

December, from 8 A.M. to midnight, excepting 11 A.M. to noon and 2 P.M. to 3 P.M.

From these it would appear that the least rain falls generally in the period of day in January, March, May, June, July, September, and December.

In the period of early afternoon and evening hours in February and October.

In the period of evening and morning hours (or night) generally in April.

At night and early morning hours in August and November.

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It therefore appears that the periods of the greatest and least rain extend over periods of several hours together; but they are different at different parts of the year.

By combining the numbers in Table II. according to seasons, considering November, December, and January as winter, February, March, and April as spring, May, June, and July as summer, August, September, and October as autumn, the next Table is formed:—

TABLE III. Showing the amounts of Rain, at the height of 50 feet above the ground, at every Hour in the Periods of Winter, Spring, Summer, and Autumn.

Seasons.	Between what Hours.																								Mean amounts of Rain.
	0h to 1h.	1h to 2h.	2h to 3h.	3h to 4h.	4h to 5h.	5h to 6h.	6h to 7h.	7h to 8h.	8h to 9h.	9h to 10h.	10h to 11h.	11h to 12h.	12h to 13h.	13h to 14h.	14h to 15h.	15h to 16h.	16h to 17h.	17h to 18h.	18h to 19h.	19h to 20h.	20h to 21h.	21h to 22h.	22h to 23h.	23h to 24h.	
Winter	in. 0·609	in. 0·659	in. 0·907	in. 0·771	in. 0·614	in. 0·610	in. 0·592	in. 0·533	in. 0·567	in. 0·530	in. 0·421	in. 0·521	in. 1·128	in. 0·914	in. 0·686	in. 0·819	in. 0·660	in. 0·803	in. 0·767	in. 0·954	in. 0·720	in. 0·933	in. 0·600	in. 0·690	in. 0·706
Spring	0·973	0·752	0·920	0·861	0·724	0·464	0·401	0·363	0·416	0·714	0·782	0·758	0·745	0·393	0·662	0·486	0·656	0·802	0·840	0·709	0·757	0·567	0·464	0·537	0·656
Summer ..	0·746	1·456	0·870	0·884	1·879	0·920	0·929	1·601	1·180	1·122	1·237	1·128	1·141	1·228	1·134	2·227	1·303	1·178	0·953	0·965	0·788	0·739	0·438	0·545	1·108
Autumn ..	0·981	0·958	1·636	1·674	1·706	1·124	0·714	0·530	0·775	1·265	0·858	0·911	0·881	1·196	1·030	1·150	1·535	1·343	1·029	1·326	0·900	1·127	0·529	0·966	1·086

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By comparing the numbers in this Table with those in the last column, it will be seen that several numbers occur together larger in amount, and several others happen together smaller in amount, than those in the last column, implying dry and wet periods of several hours' duration in each season; but these dry and wet periods do not include the same series of hours at all seasons.

In *winter* the fall of rain in the hours from 10 A.M. to 2 P.M. is less than the average, from 2 P.M. to 4 P.M. is greater, from 4 P.M. to midnight is less, and from midnight to 10 A.M., with the exception of two hours, is above the average. Essentially, at this season, the rainy period is at night, and the dry period by day.

In *spring* the distribution of rain is different: in the three hours preceding noon the amount of each hour is below the average, and in the five hours following noon it is greater; this is succeeded by four hours, up to 9 P.M., of less rain; and from 9 P.M. to 9 A.M. is essentially the wet period, the fall of rain in each hour, with the exception of two, being greater than the average hourly rainfall for the month.

In the period of *summer* the distribution of rain is again very different: the essentially dry period is from 6 A.M., extending, with the exception of two hours (one of which, that from 4 P.M. to 5 P.M., is very remarkable), to 7 P.M.,—and the principal rainfalls from 7 P.M. to 6 A.M., in every hour of which a fall greater than the average takes place.

In *autumn*, like the summer, the division between a rainy and a dry period is at 6 A.M.; from this hour, with one exception, the falls are less than the average till 2 P.M.; from 2 P.M. to 6 P.M. they are greater, again less than the average, with two exceptions, till 3 A.M., and then above till 6 A.M.

Speaking generally, the period of heaviest rainfalls,

In *winter*, is after midnight and the early morning hours.

In *spring*, in the hours immediately following noon, and those about midnight.

In *summer*, in the hours both preceding and following midnight. And

In *autumn*, in the three or four hours following 2^h or 3^h, both in the afternoon and early morning.

The next Table is formed by dividing the twenty-four hours into eight groups of three hours each, reckoning from noon; the excess and defect above and below the average in each period are

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shown in the second division of the Table, with the signs + and — affixed, the sign + indicating above, and the sign — below, the average of three hours' rain for each season.

Seasons.	Amounts of Rainfall during the Period.							
	0^h to 3^h.	3^h to 6^h.	6^h to 9^h.	9^h to 12^h.	12^h to 15^h.	15^h to 18^h.	18^h to 21^h.	21^h to 24^h.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter	2·175	1·995	1·692	1·572	2·728	2·282	2·441	2·223
Spring	2·645	2·049	1·180	2·254	1·800	1·944	2·306	1·568
Summer.....	3·072	3·683	3·710	3·487	3·503	4·708	2·706	1·722
Autumn.....	3·575	4·506	2·019	3·034	3·107	4·028	3·255	2·622
	Excess or Defect above or below the average Amounts of Rainfall.							
Winter	+·051	−0·129	−0·432	−·552	+·604	+0·158	+·317	+0·099
Spring	+·677	+0·081	−0·788	+·286	−·168	−0·024	+·338	−0·400
Summer.....	−·252	+0·359	+0·386	+·163	+·179	+1·384	−·618	−1·602
Autumn.....	+·307	+1·238	−1·249	−·234	−·161	+0·760	−·013	−0·646

From these results, it appears that in

Winter, the three three-hourly periods comprised between 3 P.M. and midnight were less than the average, and in all the five other periods there was an excess over the average.

In *spring*, the first two periods of three hours were wet, the first the wettest of any; the third, or that from 6^h to 9^h, was the driest of any; the fourth period was wet; the fifth and sixth were dry; the seventh wet; and the last, or the period before noon, was dry.

In *summer*, the two three-hourly periods before noon were remarkably dry, and the one following noon was also dry; all the others were distinguished by rain above the average.

In *autumn*, the first two periods, particularly the second, were distinguished by heavy falls of rain; and the sixth period, or that from 3 A.M. to 6 A.M., was also wet; all the other periods had rain less than the average for three hours.

By dividing the twenty-four hours into four periods of six hours each, starting from 0^h, the following Table is formed:—

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Seasons.	Amounts of Rainfall during the Period.				Excess or Defect above or below the average Amounts of Rainfall.			
	0^h to 6^h.	6^h to 12^h.	12^h to 18^h.	18^h to 24^h.	0^h to 6^h.	6^h to 12^h.	12^h to 18^h.	18^h to 24^h.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter	4·170	3·264	5·010	4·664	−0·078	−0·984	+0·762	+0·416
Spring	4·694	3·434	3·744	3·874	+0·758	−0·502	−0·192	−0·062
Summer.....	6·755	7·197	8·211	4·428	+0·107	+0·549	+1·563	−2·220
Autumn.....	8·081	5·053	7·135	5·877	+1·544	−1·484	−0·598	−0·660

These results show that rain fell in the greatest excess above the seasonal averages in the third quarter in the periods of winter and summer, and in the first quarter in those of spring and autumn, and in the greatest defect below the average for the season in the second quarter in the periods of winter, spring, and autumn, and in the fourth quarter in summer (or in the six hours preceding noon).

The greatest absolute amount of rain in these periods appears in the third quarter in summer; the next in order is the first in autumn. The smallest absolute amount appears in the second quarter in winter, and the next in order in the same quarter in spring.

By dividing the twenty-four hours into twelve-hourly periods, 0^h to 12^h (noon to midnight) for one, 12^h to 24^h (midnight to noon) for the second, 18^h to 6^h (6 A.M. 6 P.M.) for third or day, 6^h to 18^h (6 P.M. to 6 A.M.) for the fourth or night, the next Table was formed:—

Seasons.	Amounts of Rainfall during the Period.				Excess or Defect above or below the average Amounts of Rainfall.			
	0^h to 12^h.	12^h to 24^h.	18^h to 6^h (day).	6^h to 18^h (night).	0^h to 12^h.	12^h to 24^h.	18^h to 6^h (day).	6^h to 18^h (night).
	in.	in.	in.	in.	in.	in.	in.	in.
Winter	7·434	9·674	8·834	8·274	−1·062	+1·178	+0·338	−0·222
Spring	8·128	7·618	8·568	7·178	+0·256	−0·254	+0·696	−0·694
Summer.....	13·952	12·639	11·183	15·408	+0·656	−0·657	−2·113	+2·112
Autumn.....	13·134	13·012	13·958	12·188	+0·061	−0·061	+0·885	−0·885

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It appears here that the fall of rain in the twelve hours ending at midnight, in winter, is less than that in the twelve hours ending at noon, and in this respect differs from the other seasons, the fall of rain in spring, summer, and autumn being greater in the twelve hours ending at midnight than in the twelve hours ending at noon.

Comparing the falls of rain, day and night, in each season, more rain fell in the twelve hours ending 6 P.M. (day) in winter, spring, and in autumn, than in the twelve hours ending 6 A.M. (night). In summer this was not the case; a good deal more rain fell in the night period than in the day; indeed more rain fell in this period than in any other of the twelve-hourly periods in any time of the year.

By dividing the amount of rain at each hour by its frequency in that hour, the average amount of rain per fall, at every hour, in each season, on the ground, is as follows:—

	In Winter.	In Spring.	In Summer.	In Autumn.
	in.	in.	in.	in.
From 0 to 1 ...	0·025	0·040	0·035	0·035
1 „ 2 ...	0·028	0·028	0·060	0·039
2 „ 3 ...	0·033	0·028	0·038	0·053
3 „ 4 ...	0·037	0·032	0·037	0·048
4 „ 5 ...	0·028	0·032	0·082	0·055
5 „ 6 ...	0·028	0·022	0·038	0·043
6 „ 7 ...	0·027	0·023	0·037	0·033
7 „ 8 ...	0·025	0·025	0·062	0·028
8 „ 9 ...	0·027	0·025	0·047	0·035
9 „ 10 ...	0·027	0·042	0·047	0·062
10 „ 11 ...	0·027	0·043	0·057	0·038
11 „ 12 ...	0·030	0·038	0·052	0·045
12 „ 13 ...	0·048	0·038	0·048	0·040
13 „ 14 ...	0·040	0·020	0·063	0·052
14 „ 15 ...	0·028	0·030	0·062	0·052
15 „ 16 ...	0·037	0·027	0·090	0·057
16 „ 17 ...	0·028	0·032	0·057	0·060
17 „ 18 ...	0·035	0·035	0·063	0·060
18 „ 19 ...	0·030	0·033	0·063	0·040
19 „ 20 ...	0·035	0·032	0·060	0·048
20 „ 21 ...	0·032	0·030	0·048	0·035
21 „ 22 ...	0·038	0·027	0·033	0·052
22 „ 23 ...	0·025	0·028	0·030	0·035
23 „ 24 ...	0·027	0·030	0.032	0·040

In winter the heaviest rain appears to be in the two hours following midnight, and the lightest in the two hours both before and after noon.

In spring, the heaviest rains appear between the hours of 9 A.M.

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and 11 P.M.; but these are not so heavy as in winter at about midnight. The lightest falls at this season are in the hours following 1 A.M., and from 5 P.M. to 7 P.M.

In summer, the heaviest average rainfalls take place in the hour 3 A.M. to 4 A.M., and are the heaviest in the year; they are also generally larger between the hours of 7 P.M. and 8 in the morning than in any season. The least average fall per shower is that preceding noon; the fall between 4 P.M. and 5 P.M. is second only in amount to that between 3 A.M. and 4 A.M.

In autumn, the heaviest fall per shower is between the hours of 9 P.M. and 10 P.M. They are nearly as heavy in the five hours following midnight; the smallest average fall is between the hours of 7 P.M. and 8 P.M., being separated from that distinguished as the largest by one hour only.

By dividing the twenty-four hours into eight groups of three hours each, reckoning from noon, and dividing the amount of rain in each group by the frequency of rain in the same group, we have the average amount of rain per fall, as follows:—

	In Winter.	In Spring.	In Summer.	In Autumn.
	in.	in.	in.	in.
From 0h to 3h ...	0·028	0·032	0·045	0·040
3h „ 6h ...	0·032	0·028	0·052	0·050
6h „ 9h ...	0·027	0·025	0·048	0·033
9h „ 12h ...	0·028	0·040	0·052	0·048
12h „ 15h ...	0·038	0·028	0·057	0·048
15h „ 18h ...	0·033	0·032	0·072	0·058
18h „ 21h ...	0·033	0·032	0·057	0·040
21h „ 24h ...	0·027	0·028	0·037	0·043

The heaviest average fall in the groups of three hours is,

In winter, 12^h to 15^h; in spring, 9^h to 12^h; in summer and autumn, 15^h to 18^h.

And the lightest,

In winter, 6^h to 9^h and 21^h to 24^h; in spring, 6^h to 9^h; in summer, 21^h to 24^h; and in autumn, 6^h to 9^h.

By dividing the twenty-four hours into four groups of six hours each, and treating them in the same way, we find that the average fall of rain per fall

In winter is 0·035 in. in the six hours ending at 6 A.M., 0·032 in. in that ending at noon, 0·030 in. in that ending at 6 P.M., and 0·027 in. in the remaining six hours ending at midnight; the average amount of rain per fall is greatest in the first of these periods, and successively less in each succeeding period.

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In spring, the average fall is smallest, viz. 0·030 in., in the six hours ending at 6 A.M. and in that ending at noon; it is a little larger in the six hours following noon, viz. 0·032 in., and is the largest, viz. 0·033 in., in that ending at midnight.

In summer, the heaviest average falls are in the six hours ending at 6 A.M., being 0·065 in., and decrease each successive six hours, being ·050, ·048, and ·047 respectively, the last corresponding to the six hours preceding noon.

In autumn, the largest is 0·053 in., in the six hours ending at 6 A.M.; the next in order is 0·048 in., in the six hours following noon; the next 0·042 in., in the six hours preceding noon; and the smallest 0·040 in., in the six hours preceding midnight.

Treating the results in twelve-hour periods, the average amount per fall in the twelve hours ending

	In Winter.	In Spring.	In Summer.	In Autumn.
	in.	in.	in.	in.
At midnight	0·028	0·032	0·050	0·043
At noon	0·033	0·030	0·057	0·047
At 6 A.M. (night)	0·028	0·025	0·057	0·038
At 6 P.M. (day) ...	0·033	0·038	0·042	0·053

From this the rain per shower is heavier by day than by night in winter, spring, and autumn, but in summer is heavier by night than by day.

By treating the number per month, irrespective of the times of the day, we find the average amount per fall in each month, is as follows (arranged in the order of magnitude) :—

	in.
May	0·058
June	0·050
July	0·048
August	0·048
October.....	0·047
September.....	0·042
November.....	0·040
April	0·035
February	0·030
January.....	0·028
March	0·028
December	0·023

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Here the months of May to November group themselves together, and in the order of the months, with one exception, viz. October, which month takes precedence over September, in the heavier falls. The remaining five months are intermixed among each other; but the difference in the average per fall in the months December to March is small, and April, which is 0·035 in., is as much above February, 0·030 in., the largest of the winter months, as it is below November, 0·040 in., the smallest of the May to November group. The greatest difference from month to month is from November to December, the average per fall being 0·040 in. in the former, and 0·023 in. in the latter month, which is the smallest of any in the year.

XIV. *On the Influence of the Moon upon the Fall of Rain in respect to her age.* By George Dines, Esq., F.M.S.

[Plates V. & VI.]

The Moon's influence upon the various changes which take place in the weather has always been a subject of discussion; and opinion, even at the present time, is much divided upon the question. This has induced me to prepare the following paper, which relates exclusively to rainfall.

By the kindness of Miss Caroline Molesworth, of Cobham Lodge, Surrey, whose valuable journal, kept by herself, from the commencement of the year 1825 to the present time, has been placed at my disposal for the purpose, I have been enabled to extract the rain which fell during each day of the moon's age, for a period extending (with few interruptions) over forty years; and from this extract the following Tables have been prepared, before proceeding to which, a few explanations are necessary.

The days given in the Tables refer to the moon's age only, the calendar days and months being altogether disregarded. But as the times of new and full moon occur at all hours of the day, while the rainfall has been entered in the journal each morning of the day upon which it was taken, to prevent confusion, the following mode has been adopted throughout. Supposing the moon's change to have occurred between 9 A.M. and 9 P.M., the rain recorded upon the following morning is taken as the first day's rain; but if the change occurred, for instance, between 9 P.M. and

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9 A.M., on the night of the fifth and sixth days of the calendar month, then the rain recorded on the morning of the seventh is taken as the first day's rain. The average time from moon to moon being nearly 29 days 12 hours 44 minutes, rather more than every other moon is made to extend to 30 days; but as the last day really represents only 12 hours 44 minutes, before taking the averages, the rain recorded as having fallen upon that day is supposed to be increased in the proportion of 12 hours 44 minutes to 24 hours. The rain which fell upon each day is then added up, and the daily average for each period of years calculated. For easier reference, that average is considered as 100, so that, by looking at the Tables, it can be seen at once how much per cent. the rain which fell at any particular period was above or below the average.

For various reasons, but principally owing to Miss Molesworth's absence from Cobham, the rainfall at different times in the journal has not been entered daily, but only at the end of the month. Where this has occurred, I have considered it best to omit those moons altogether from the calculation. At other times, owing principally to frost and snow, the rain was allowed to accumulate in the gauge for a few days; but as a full description of the weather on those days is entered in the journal, the rain has been taken for the different days as near as it could be; these days are marked in my abstract, and do not amount, either in time, or quantity of rain which fell, to quite 2 per cent., and therefore cannot much affect the figures given in the Tables. The averages are calculated to the first decimal places; but, with few exceptions, I have not thought it necessary to give them in the Tables, but have taken the nearest whole number. In Table I., which may be said to form the basis of the other Tables, the average of five years is given; but, to prevent overloading the paper with figures, longer periods only are inserted in most of the Tables.

The total number of moons from which the Tables are calculated is 460; the number omitted, for the reason stated, 35. The total quantity of the rainfall for the 460 moons was 888·38 inches (over 74 feet in depth).

Table I. gives the comparative quantity of rain which fell upon each day of the moon's age, during the various periods of years. The most noticeable features in this Table are the following:—The rain which fell on the 22nd day of the moon's age is in all cases

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above the average, when a period of five years is taken; but this rule does not apply if the years are taken singly. The greatest quantity of rain appears to have fallen upon the 10th day; but this is counterbalanced by the fact that on the day following, the 11th, less rain has fallen than upon any other day.

In Table II. the time of each moon is supposed to be divided into eight parts, by grouping together the days before and after each change of the moon and the intermediate days, the average of rainfall being still considered as 100.

In Table III. the time of each moon is divided into four parts of 7½ days each (the 8th and 23rd days being divided), and shows the rain which fell in each of the four quarters, the average being still taken as 100.

TABLE I.

	Periods of Five Years.								Ten Years.				Twenty Years.		Forty Years.
	1825 to 1829.	1830 to 1834.	1835 to 1839.	1840 to 1844.	1845 to 1849.	1850 to 1854.	1855 to 1859.	1860 to 1864.	1825 to 1834.	1835 to 1844.	1845 to 1854.	1855 to 1864.	1825 to 1844.	1845 to 1864.	1825 to 1864.
1	100	113	99	107	152	142	28	66	106	103	148	49	105	98	103
2	87	112	74	92	96	69	70	139	99	83	84	107	91	96	93
3	132	132	81	75	82	126	56	82	132	78	102	70	105	86	96
4	116	70	77	97	136	99	67	104	94	86	119	87	90	103	96
5	92	138	119	124	103	87	137	59	114	121	96	94	118	95	107
6	63	172	166	58	100	74	164	107	115	112	86	135	114	111	112
7	69	69	103	106	139	74	78	49	69	104	109	62	87	86	87
8	103	86	105	89	90	112	74	121	95	97	100	99	96	100	98
9	87	138	76	99	126	113	78	104	111	87	120	93	99	106	103
10	120	132	159	123	88	177	117	134	126	141	129	126	133	128	130
11	77	64	83	109	66	87	90	77	71	96	76	83	83	79	82
12	83	135	98	125	131	91	106	117	108	111	113	112	110	113	111
13	117	138	122	113	72	38	105	79	127	117	57	91	122	74	100
14	92	79	77	134	58	102	70	79	86	105	78	74	95	76	87
15	105	47	141	115	106	115	115	64	76	128	110	87	102	99	101
16	86	108	84	92	101	146	128	105	97	88	122	116	92	119	104
17	49	93	143	97	85	41	114	124	70	120	65	120	95	92	93
18	83	62	101	81	105	101	121	115	72	91	103	118	82	111	95
19	147	72	115	128	75	71	75	113	110	122	73	96	116	85	101
20	96	51	86	97	75	67	150	98	74	92	71	122	83	96	89
21	103	90	69	126	56	150	105	126	97	97	99	117	97	108	102
22	126	115	149	100	107	137	117	137	120	125	121	128	122	125	123
23	85	54	117	93	95	124	69	95	70	105	108	83	87	96	92
24	116	99	55	76	96	55	179	68	108	65	77	118	86	98	91
25	101	166	41	94	103	123	79	95	133	68	113	87	100	100	100
26	140	125	88	70	72	145	82	136	133	79	105	111	106	108	107
27	94	113	110	109	121	85	59	97	104	109	105	79	107	92	100
28	102	70	69	96	115	69	69	155	87	82	94	116	84	105	94
29	87	76	74	107	156	58	171	72	82	90	111	117	86	114	99
30	146	84	124	69	93	124	126	88	116	96	107	105	106	106	106

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Table II.

Groups of Three or Four Days preceding and following each Change of the Moon.	Periods of Ten Years.				Twenty Years.		Forty Years.
	1825 to 1834.	1835 to 1844.	1845 to 1854.	1855 to 1864.	1825 to 1844.	1845 to 1864.	1825 to 1864.
1st, 2nd, 29th, and 30th days	101	93	112	94	97	104	100·3
3rd, 4th, 5th, and 6th days	114	100	101	97	106	99	102·7
7th, 8th, and 9th days	92	97	110	85	94	98	95·9
10th, 11th, 12th, and 13th days	108	117	93	103	112	98	105·6
14th, 15th, 16th, and 17th days	82	111	94	99	97	96	96·4
18th, 19th, 20th, and 21st days	89	101	86	113	94	99	96·6
22nd, 23rd, and 24th days	99	99	102	110	99	106	101·9
25th, 26th, 27th, and 28th days	114	85	104	98	99	101	100·0

Table III.

Period.	Periods of Ten Years.				Twenty Years.		Forty Years.
	1825 to 1834.	1835 to 1844.	1845 to 1854.	1855 to 1864.	1825 to 1844.	1845 to 1864.	1825 to 1864.
New Moon to First Quarter...	104	98	106	87	101	97	99·1
First Quarter to Full Moon..	100	112	98	95	106	97	101·6
Full Moon to Third Quarter	90	104	94	114	98	104	100·4
Last Quarter.....	106	86	102	103	96	103	98·9

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The number of days on which ·01 in. or more of rain fell during the entire period of 460 moons is 6257.

On the	1st	days of the moon's age it rained				210	times.
"	2	"	"	"	"	213	"
"	3	"	"	"	"	207	"
"	4	"	"	"	"	207	"
"	5	"	"	"	"	213	"
"	6	"	"	"	"	224	"
"	7	"	"	"	"	201	"
"	8	"	"	"	"	208	"
"	9	"	"	"	"	207	"
"	10	"	"	"	"	231	"
"	11	"	"	"	"	205	"
"	12	"	"	"	"	203	"
"	13	"	"	"	"	199	"
"	14	"	"	"	"	199	"
"	15	"	"	"	"	194	"
"	16	"	"	"	"	209	"
"	17	"	"	"	"	203	"
"	18	"	"	"	"	218	"
"	19	"	"	"	"	224	"
"	20	"	"	"	"	209	"
"	21	"	"	"	"	204	"
"	22	"	"	"	"	245	"
"	23	"	"	"	"	216	"
"	24	"	"	"	"	214	"
"	25	"	"	"	"	219	"
"	26	"	"	"	"	205	"
"	27	"	"	"	"	208	"
"	28	"	"	"	"	215	"
"	29	"	"	"	"	217	"
"	30	"	"	"	"	221	"

The average of the above is 211·6 times.

Divided into four parts of $7\frac{1}{2}$ days each, this gives

New moon to first quarter...	1579 times	Average 1587 times for each quarter.
First quarter to full moon ...	1542 "	
Full moon to third quarter...	1620 "	
Last quarter.....	1607 "	

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The number of days on which ·25 in. or more of rain fell during the same period is 1105.

On the	1st	days of the moon's age this occurred				43	times.
,,	2	,,	,,	,,	,,	39	,,
,,	3	,,	,,	,,	,,	38	,,
,,	4	,,	,,	,,	,,	38	,,
,,	5	,,	,,	,,	,,	38	,,
,,	6	,,	,,	,,	,,	43	,,
,,	7	,,	,,	,,	,,	32	,,
,,	8	,,	,,	,,	,,	37	,,
,,	9	,,	,,	,,	,,	37	,,
,,	10	,,	,,	,,	,,	50	,,
,,	11	,,	,,	,,	,,	27	,,
,,	12	,,	,,	,,	,,	46	,,
,,	13	,,	,,	,,	,,	31	,,
,,	14	,,	,,	,,	,,	28	,,
,,	15	,,	,,	,,	,,	43	,,
,,	16	,,	,,	,,	,,	42	,,
,,	17	,,	,,	,,	,,	31	,,
,,	18	,,	,,	,,	,,	38	,,
,,	19	,,	,,	,,	,,	37	,,
,,	20	,,	,,	,,	,,	29	,,
,,	21	,,	,,	,,	,,	41	,,
,,	22	,,	,,	,,	,,	46	,,
,,	23	,,	,,	,,	,,	38	,,
,,	24	,,	,,	,,	,,	29	,,
,,	25	,,	,,	,,	,,	37	,,
,,	26	,,	,,	,,	,,	48	,,
,,	27	,,	,,	,,	,,	37	,,
,,	28	,,	,,	,,	,,	31	,,
,,	29	,,	,,	,,	,,	34	,,
,,	30	,,	,,	,,	,,	37	,,

The average of the above is 37½ times.

Divided into four parts of 7½ days each, this gives—

New moon to first quarter.....	289 times	Average 281 times.
First quarter to full moon.....	281 ,,	
Full moon to third quarter ...	288 ,,	
Last quarter	272 ,,	

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OF
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SESSION 1867–68,

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EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

1868, APRIL 15.

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JAMES GLAISHER, Esq., F.R.S., President.

Vol. IV. 1868, APRIL 15. [No. 37.

JAMES GLAISHER, Esq., F.R.S. &c., President, in the Chair.

R. C. Cann Lippincott, Esq., Highcliffe House, Eastbourne;
Charles Meldrum, Esq., M.A., Mauritius;
Rev. William Previté, M.A., Little Wratting, Haverhill, Suffolk;
were balloted for and duly elected Fellows of the Society.

XV. *On the Rainfall in Natal, South Africa.* By R. J. Mann, Esq., M.D., F.R.A.S., F.R.G.S., &c., Superintendent of Education in the Colony.

I propose, in this communication, to resume the subject which I brought before the Meteorological Society of London at its Meeting in the month of February in last year; I then stated the general results of my observations of the "Variations of Atmospheric Pressure in the Colony of Natal," extended through a continuous series of eight years. I now submit, in continuation of that record, a similar abstract of the conclusions at which I have arrived in regard to the law of rainfall, a result immediately

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following from the movements of the air which are expressed in the oscillations of the barometer.

The actual rainfall in Natal does not very materially differ from that of some portion of the British Isles. The fall for the eight years extending from 1858–65, at Maritzburg, 2095 feet above the sea, was:—

	inches.
1858	27·42
1859	28·40
1860	30·60
1861	22·41
1862	29·91
1863	34·66
1864	37·31
1865	31·08

The entire fall for the eight years, if the water had remained where it fell, would have given a depth of 241 inches, or a trifle over 20 feet; the mean annual fall for this eight years' period was 30·23 inches. The rain-gauge, from which the register was made, was placed 6 feet above the ground; the receiving surface of the gauge was the mouth of a square funnel measuring 6 metres on each side.

The range taken by the yearly fall during this series of years is expressed to the eye by the diagram, Fig. 1. It will be observed in this that the fall was very nearly at the mean in the year 1860, that it subsided to the lowest point in 1861, that it then gradually rose to the highest point in 1864, and that in 1865 it was again very near to the mean.

But although the mean annual rainfall in Natal is very nearly the same with the mean annual rainfall of some parts of England, the distribution of the rainfall through the several months of the year is by no means analogous to the same distribution in England. There is in Natal a remarkable approach towards the development of the true tropical wet and dry season. More than four-fifths of the year's rain falls in the six months of the summer, and less than one-fifth falls in the six months of the winter.

The actual rainfall for each month of the year, given as an average derived from a period of eight years, extending from 1858–65, is expressed in the following statement:—

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Fig. 1. Annual amount of Rainfall for a period of Eight Years.

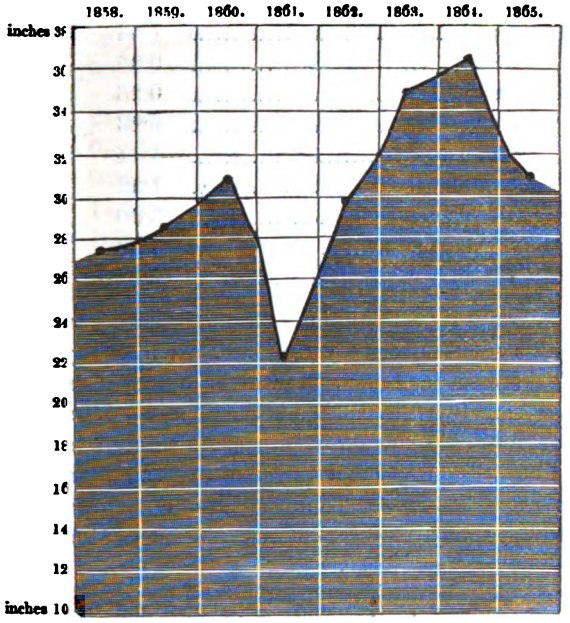
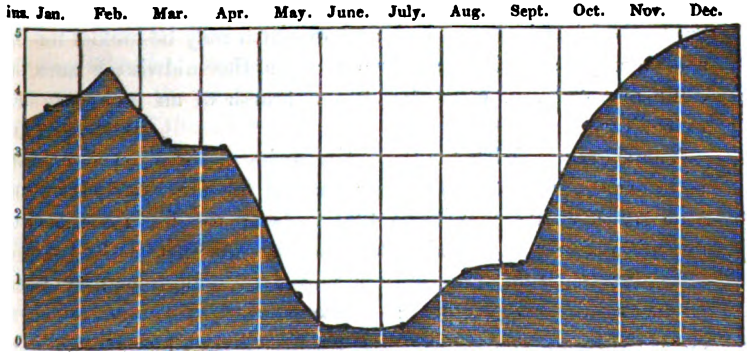


Fig. 2. Mean Rainfall for each Month of the Year.



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	inches.
January	3·92
February	4·41
March	3·29
April	1·44
May	0·95
June	0·26
July	0·23
August	1·14
September	1·32
October	3·60
November	4·58
December	5·04

The law of monthly distribution of rainfall, so far as it can be derived from a series of eight years' observation, is expressed to the eye in the diagram Fig. 2. It will be observed in this diagram that the month of December is the focus of the wet season (if the freedom of such an expression may be allowed for the sake of forcible illustration), and that the month of July is the focus of the dry season. The gradient of increase is more rapid and abrupt with the return of the rains than the gradient of decrease that indicates their subsidence.

But the seasons of Natal may with greater accuracy be divided into three grades, namely, the wet and dry seasons, and the intermediate or transition periods that lie between them. Thus there are six months in the year, namely those of October, November, December, January, February, and March, in which four inches and nearly one-fifth of rain may be looked for in each month; there are four months, namely those of April, May, August, and September, in which one inch and one-fifth may be looked for in each month; and there are two months, the midwinter ones of June and July, in which barely one-fourth of an inch may be looked for.

The average rainfall for the entire series of the six wet months is, in exact figures, 24·84 inches; the fall for the entire series of four intermediate months is 4·85 inches; the fall for the two dry midwinter months, taken together, is 0·49 inch.

The average number of days on which slight rain occurs in each of the two dry months is $1\frac{1}{2}$; the average of the number of days on which rain may be looked for in each of the four intermediate months is $6\frac{1}{4}$; the average of the number on which it may be ex-

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pected in each of the six wet months is 15¾. Rain falls in the city of Maritzburg on about 124 days in the year, and there are about 241 days in the year on which no rain is seen.

The exact number of days on which rain falls in the several months of the year, on an average taken from a series of eight years, is expressed in the following statement:—

	days.
January	16
February	14
March	13
April	9
May	3
June	1
July	2
August	5
September	8
October	17
November	17
December	18

This distribution of the rainfall in Natal, so that four-fifths of it occurs during the hottest half the year, is a direct result of the physical configuration and geographical position of the land. In the preliminary sketch of the "Leading Features of the Climate of Natal," which I prepared for the Society in the month of June 1866 (see page 203 of the 'Proceedings' of the Society for 1866), I described these peculiarities somewhat in detail. On this account it will be sufficient for the present purpose here to recal the statement that the entire stretch of the colonial territory is simply the bevelled rim of the great tableland of Africa, by which the vast central mass subsides suddenly, from an elevation exceeding 6000 feet, to the sea. The general breadth of this sloping rim varies, in the situation of Natal, from 120 to 160 miles; but in the case of the colony, the gradient of the land is made even more severe than this would imply, by the fact that there issues from the inland mountain-frontier (the broken edge of the central table) a scarcely subordinate ridge, which crosses the entire central district of the colony as a vast highland tract, that is above 5000 feet high through the greatest part of its extent, and that has portions several hundred feet above this.

The main inland thoroughfare of the land, from the port, passes over this highland, at a distance of seventy miles from the sea, by

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a route that is there over one mile (in exact numbers, 5100 feet) high; the first gradient of the land is therefore a slope of one in seventy. Now the central portions of this land-slope lie not more than 400 miles away from the portion of the earth where the sun shines down vertically at the hour of noon in the midsummer of this southern hemisphere—in other words, from the southern tropic; the consequence is, that every day the air resting over the slope becomes strongly heated by the intense sunshine so long as the sun returns to its high summer noontide elevation in the sky: the heated air is then necessarily drawn upwards along the slope by the superior pressure of the lower and cooler atmosphere; but this lower and cooler atmosphere rests over the sea. The bevelled rim of the African continent, between the 28th and 32nd parallels of southern latitude, where Natal is situated, looks directly out to the Indian Ocean; the prevalent set of the air-currents is thus from the ocean to the land. A sea-breeze is almost constantly blowing, at least during the hotter portion of the day. My observations of the direction of the wind in the year 1865, which may be taken approximately as a fair illustration of what occurred in the other years of the series, gave me

At 9 in the morning—		
An on-shore wind (E., S.E., or S.)	238	times.
An off-shore wind (W., N.W., or N.) ...	77	„
An along-shore wind (N.E. or S.W.) ...	50	„
At 3 in the afternoon—		
On shore	296	„
Off shore	28	„
Along shore	41	„
At 9 in the evening—		
On shore	286	„
Off shore	40	„
Along shore	39	„

Thus, in a series of 1095 evenly distributed observations, the wind was blowing off the sea on 820 occasions; and the natural set of the air-current of the sea was only interrupted during this year

On 69 days in the afternoon,
On 79 days in the evening, and
On 127 days in the morning.

Now a sea-breeze is naturally a moist one, and this more espe-

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cially when, as in this part of the Indian Ocean, a current of warm water sets up along shore from the lower latitudes about the Indian peninsula. If, then, the land upon which this moist sea-breeze off the Indian Ocean is thrown were a cool one, its heights would be of necessity enveloped in enduring mists and fogs. As the land is not a cool one, but a warm one, this result does not ordinarily take place; the sea-breeze goes in over the land slope, sliding up, becoming warmer and warmer as it does so, and therefore still sustaining its large burthen of invisible vapour and its transparency. But at last it gets so warm and so light, that it leaves the ascending land with a bound, and goes off after the fashion of a very light balloon, or of the up-cast in a heated chimney, into still more elevated regions of the atmosphere; there, freed thus suddenly from a considerable amount of superincumbent pressure, it expands still more, and under this expansion loses its ability to carry the load of invisible vapour that it had before sustained; the invisible vapour, therefore, condenses into visible mist and cloud, and very soon pours down copiously as rain, with the accompaniment of electrical manifestations developed by the abundant and rapid condensation. In all probability this condensation is also aided by the up-burst taking place towards the period of the day when the declining sun is laying aside some portion of its direct heating power.

It will be understood, from the preceding description and explanation, that the rainfall in Natal is principally of the character of thunderstorm-rain. There are about ninety-five days on which rain falls at Maritzburg in the six wet months, and there are about fifty-one thunderstorms over, or near to, the town within the same period. Many of the other rain-days are, no doubt, days on which either there are thunderstorms somewhere just beyond the reach of eye or ear, or on which the condensation of moisture is of the same general character, but not altogether rapid or copious enough to give rise to electrical manifestation. There are about twelve thunderstorms over or near Maritzburg during the six dry months, of which only one occurs, upon the average, during the two midwinter months of June and July. The dryness of the winter season is due to the fact that, at that period of the year, the sun's heat is not sufficiently intense to give rise to the energetic upward movements of the air upon which the rapid and copious condensation of invisible moisture depends; the same general action goes on, but in much lower intensity and energy. The

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clouds may be seen piling themselves round the higher hills in the afternoon, but they do not spread often to the lower regions, as in summer time; there is still the attempt to get up the thunderstorm, but the attempt is for the most part abortive. The thunderstorm is actually developed at this season only on comparatively rare occasions.

During the period of eight years, extending from 1858 to 1865, there were 422 thunderstorms at Maritzburg, or, to speak more exactly, 422 days on which thunderstorms occurred there; for on some of these days there were many storms following each successively. There were also 213 other days on which lightning was seen from Maritzburg without thunder being heard; that is, days on which there were, in all probability, storms somewhere within twenty miles.

The greatest rainfall that occurred in each of the twelve months, during the series of eight years already specified, is given in the following statement:—

	Greatest fall in eight years. inches.
January	6·63
February	7·59
March	5·04
April	2·02
May	2·94
June	1·28
July	0·74
August	3·44
September	3·11
October	7·21
November	8·95
December	6·23

The largest monthly fall at a station 2095 feet above the sea was therefore 8·95 ins.

The greatest number of thunderstorms that occurred at Maritzburg, in each of the twelve months during the same period, was—

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January	12
February	10
March	9
April	7
May	6
June	1
July	2
August	3
September	10
October	14
November	12
December	11

The thunderstorm-rain in Natal falls most certainly and constantly with the low barometer. The most general rule is, that there are storms and rain on several successive days at the periods when the atmospheric pressure is, so to speak, in its troughs. With the rise of the barometer, and the crest of the atmospheric waves, there comes a period when both rains and storms intermit for a similar period; then the barometer begins to fall, and the storms and daily rainfalls recur. It is thus clear that the great alternating oscillations of the atmosphere, which have been spoken of upon another occasion (see page 343 of the 'Proceedings' of the Society, 1867), have to do with, or at least influence to a considerable extent, the rapid and copious condensation of the invisible vapour which leads to the storms and rain. When the great air-movement *from the north* predominates over its southern antagonist, the vapour is retained in suspension, and the recurrence of the paroxysm of condensation is checked. The rule of the rainfall in Natal, therefore, seems to be afternoon rain occurring on three or four, or even more days in succession, with intervals of three, four, or more days without rain. This rule, however, is not absolute; sometimes the afternoon rain falls on single isolated days.

Perhaps the most direct indication that the rainfall in Natal is, in the main, due to the influences to which it has been attributed, will be found in the fact that out of the 780 days on which rain fell during six years of the series of my observations, that is, from 1860 to 1865, it began to fall *after noon* on 577 days, and before noon on 123 days. In the 123 days of morning rain there were forty-two occasions on which marked sea-gales were bringing in

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the rain; and these gales always continued from two to three days, so that in this way the series of 123 morning rains is fairly accounted for. The thunderstorm-rains (with low barometer) are to the sea-rains (with high barometer) nearly as five to one.

The number of times at which, during these six years, rain commenced at the several afternoon hours of the day is expressed in the following series:—

At 1 o'clock	.....	29 times
2 „	.....	33 „
3 „	.....	71 „
4 „	.....	71 „
5 „	.....	59 „
6 „	.....	108 „
7 „	.....	61 „
8 „	.....	28 „
9 „	.....	52 „
10 „	.....	13 „
In the night	.....	52 „

More than two-thirds of the thunderstorm-rains commenced between the hours of 3 and 7; one-fifth began about 6 in the evening.

It will be hardly necessary that I should here remark that, in touching this question of the way in which the abundant periodic rainfall of Natal is brought about and sustained, I have only intended to indicate the conditions and forces which are concerned, in the broadest way. There is yet need for much more close study and investigation of this most interesting subject before a full and sufficient explanation can be given of the agency by which the paroxysms of sudden and copious condensation are caused and ruled; it can, however, certainly be safely said that the strong, almost tropical, summer sunshine, the steep land-slope with its ocean aspect, and the prevalent, though intermitting, sea-breeze are the conditions and powers that are at the bottom of the business.

The actual amount of rain that falls in Natal within a given short period is, however, by no means excessive for a land approximately tropical, excepting upon very rare occasions in the coast districts, of which more special notice will be taken immediately. The nine heaviest rainfalls, within twenty-four hours, at Maritzburg during the period of eight years of observation were:—

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	in.
November 18, 1864	1·70
December 8, 1864	1·70
December 16, 1863	1·72
May 24, 1863	1·80
February 19, 1864	1·89
October 22, 1863	2·20
January 29, 1862	2·26
December 9, 1861	2·37
January 1, 1865	2·50

There were thus only four occasions, during eight years, on which the daily fall exceeded 2 inches; and the heaviest daily fall in that period was 2½ inches. Upon one occasion only I noted a trifle more than 1 inch within an hour.

The seven most marked clusters of rainy days gave connected falls of between 3¼ and 6½ inches. These notable falls were:—

	in.		
In November 1859	3·48	in	4 days
December 1863	4·20	in	5 „
February 1864	4·40	in	9 „
October 1863	4·60	in	6 „
December 1864	5·10	in	11 „
January 1865	5·40	in	13 „
November 1860	6·50	in	9 „

Rainfalls of this character are, nevertheless, capable of keeping the rivers in flood for considerable periods during the summer season. Streams that are easily forded on horseback, with the water scarcely above the horse's knees all winter long, can then, for weeks at a time, only be passed by swimming through rapid turbulent streams, or by a boat. The description so forcibly and graphically given by Sir Samuel Baker, in writing of a territory situated on the same side of this great continent, but some 40° of latitude further to the north, of the sudden rise of African rivers, is, in a measure, quite borne out by experience in Natal. The only marked difference is, that in Natal, owing to the peculiar circumstances of its configuration and rainfall, which have been here described, the rivers never dry up; all winter long there are still abundant streams of fresh water in all the river-channels. The first time I personally encountered the sudden rise of a Natal river occurred in the month of November in the year 1859. I

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was upon this occasion making a short visit to one of the magistrates of the up-country district, who resided in the township of Weenen, on the north bank of the Bushman's River, a tributary of the Great Tugela, whose sources are fed by the higher Drakenberg. We arranged to make a trip together into a neighbouring tract of interesting bold country lying to the south of the river, and we passed the river on horseback one morning by the usual ford, where the river was, at the time, but a little above the horses' knees. We rode about sixteen or twenty miles through a series of beautiful thorn-valleys, which are here hemmed in by grand hills quite passing into the dimensions of mountains. At the end of our ride we climbed the shoulder of the mass of the Umhlumba Mountain by a precipitous stony path, and so reached the table-land district lying on the further side of the mountain, where we passed the night at a settler's house. On the following day we started to retrace our steps by the same route at a little after noon. As we descended from the mountain a thunderstorm burst upon us, and we had to make our way down as best we could along a ravine, which was then fast getting transformed into a foaming torrent. We rode on rapidly through the valleys in the still falling rain, with the tempest raging around us; and as we approached the Bushman's river, we saw sweeping down upon us, from the open country towards the north, what seemed like a solid wall of blackness, that went nearer to justify to my mind the expression "a darkness that could be felt" than any other phenomenon of this kind that I have encountered. As this most unwelcome visitant was upon us, we reined up our horses in the gap cut through the high bank of the river, and there before us, where we had ridden through, ourselves dry footed, about thirty hours before, there was now a roaring flood, which we afterwards ascertained to have been more than 20 feet deep, turbid with suspended sediment, and broken by waves of formidable dimensions, which were rolling down huge fragments of trees torn from the banks in the higher stretches of the river. We took shelter and council in a deserted house, standing hard by, for a brief period, and then endeavoured to make our way to the point of the river-bank which was immediately opposite to my friend's residence by skirting the outer face of a range of hills that here closely hug the stream, and by then sliding and scrambling down a steep precipice, clinging at times to the branches of brush-wood, and at imminent risk of having our horses, that we were

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leading by the bridle, roll over us. After a toilsome passage of the precipice (I fear rather ignobly accomplished in some particulars on my own part), still in a deluge of rain, we stood at length once more upon the bank of the swollen river,

"Full to the banks, close on the promised good;"

for there, immediately beyond, waved in the gusts of the storm, in full sight, the feather-like plumes of my friend's blue-gums. After some half-hour of vain signalling, we at length established a communication with the further side, but only to learn that the boat, our last hope, had been swamped in the first rush of the rising flood, and was then lying at the bottom, secured by its chain, but riddled full of holes. Time and space do not permit the rest of our adventures to be related here; if they did, there would appear in the narrative other arrests by swollen streams in the fading twilight; a sleepless night, spent in wet clothes, in the hut of a wild Kafir, amid cockroaches, fleas, pungent wood-smoke, and a bevy of nude dusky damsels and dames ranged in close file round the interior of the human bee-hive to do honour to the unexpected, and, so far, at least, as one of them was concerned, most unwilling guests; futile efforts to consider dry saw-dust and dirty sour gruel in the light of a repast; a saddling up under the cloudless sky of an early dawn; long hours spent under a scorching sun, in the maze of a vast unpathed valley, in which every stream that was encountered was found to be a bottomless torrent, and where all had to be finally circumvented by climbing to the highest crest of the watershed, whence there was a glorious uninterrupted prospect quite across to the blue hills of Zululand, beyond the north-eastern frontier of the colony; a late afternoon's repast, after ten hours in the saddle and twenty-six hours fasting, at a Dutch homestead upon hard-boiled eggs and boer's-meal bread; a long pause in the evening on the bank of the Great River, where the main northern road to the interior crosses it, until the flood had sufficiently subsided to allow the ferry-boat to stem the stream; the swimming of the horses through the still seething and roaring waters; and, finally, the escape from the prolonged miseries to a very comfortable house of public entertainment which stands here on the further bank of the ford. It would have taken a very strong reason indeed to have induced me to give up my grasp upon this most welcome haven when I had once secured it; but my friend, the magistrate, being now on

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the right side of the river, started off for home, a distance of some thirty miles, on a fresh horse. He did not, however, reach it on this occasion; he and his fresh horse, by some misunderstanding, parted company by the way, and in his attempt to pass through a small river to get back to me, he was carried down the stream, although a bold and practised swimmer, and dragged out some distance down the bank by Kafir attendants who were watching him. At daybreak he found another horse somewhere, and so managed to join me at breakfast at my comfortable hotel, where he had a very different night's experience to relate to that which I had to tell. The meteorological bearing of this episode is, that the rainfall of the first day of the adventure, at the city of Maritzburg, standing 1100 feet lower, was 1·64 inch, and that the entire rainfall on this occasion was that which has been noted as 3·48 ins., falling in four days in the month of November 1859. The fall was 0·68 and 0·83 of an inch for each of the two days previous to the great storm; 1·64 for the day of the storm, which reached Maritzburg, sixty miles south of my wanderings, at 2 in the afternoon; and 0·31 of an inch for the following day. There then ensued four entirely rainless days, I suppose to allow the accumulated floods to get away.

It has been stated that rain falls in Natal with a high as well as with a low barometer. The meaning of this is, that the ordinary thunderstorm-rains occur, for the most part, when the atmospheric pressure is low; but that rain also falls when a strong sea-gale from the south-east strikes the land, and when the atmospheric pressure is high in consequence of the set of the air from the cold south. These sea-rains generally continue for from two to three days, and they may occur at any period of the year. They are familiarly known to the colonists as the "three days' rains." When they happen, the deposit of rain is heaviest upon the coast, and grows progressively lighter and lighter with ascent into the uplands, until, among the higher hills, it is little more than a soaking "Scotch mist." In the early part of the month of June (so generally a dry month), in the year 1865, I chanced to be travelling on the coast when one of these rains occurred. I passed the large river Umkomanse by a ferry-boat, but was stopped at the next stream, the Amahlongwa, by the violence and depth of the current. I could not retrace my steps because there were other boatless rivers behind me. I took refuge with some other travellers at a mission station, where, however, the family

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was absent, for some days; and our daily amusement consisted in experimental visits to the river to test the depth of the water. After six days' detention, we got across, with the water still above our horses' saddle-bows, and also passed the next river; but the third in succession, the Umzinto, was still of unmanageable depth. On the following day a settler, quite conversant with the peculiarities of its ford, attempted to pass it, but was carried down the stream; so I now gave up all further efforts, and made my way back to Maritzburg by ascending the ridge, or watershed, between the rivers. At a distance of forty miles from the sea I forded the large river Umkomanse, with the water only half way up my saddle. When I reach home, I found that at Maritzburg, fifty-four miles inland by the line of the road, and 2090 feet above the sea, the entire rainfall had only amounted to 1·23 inch, of which 1·01 inch had fallen on one day; the rainfall on the coast for the same period was 8·97 inches. The following statement gives the detail of this remarkable rainfall on the coast day by day:—

	inches.
June 5	0·70
6	2·01
7	0·00
8	1·86
9	0·70
10	1·70
11	2·00

There then followed thirty-one days without a single drop of rain, the more usual state of affairs at this season of the year.

In the year 1856, a coast deluge of this character of a still more extraordinary kind occurred. On that occasion rain fell in torrents during three days, from the 14th to the 16th of April, with a violent gale from the sea. The river Umgeni rose 28 feet above its usual height within a couple of miles of its mouth, and overflowed the greater portion of the sand-flat on which the town of the Port of Durban is built. The River Tongaat rose 30 feet, and the River Umvoti 16 feet, above the usual level; the latter stream spread a bed of sand 4 feet thick over the neighbouring flat pastures at the lower part of its course. The sea-beach was covered with trunks of large trees and vast deposits of reed, brought down by the turbulent streams and then cast back from the ocean by the breakers. One observer counted the bodies

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of 200 dead oxen lying along the sea-sands within ten miles of the mouth of the Umgeni. The bridge over the Umsinduse, at the entrance of Maritzburg, was swept away, and all communication between the port and the city was interrupted for some days. It is stated that the rainfall at Durban, on this disastrous occasion, amounted to 27 ins. in the three days, that the fall at Maritzburg was under 11 inches, and that the Bushman's River, sixty miles higher up, and the seat of my adventures three years subsequently, was scarcely swollen. The gentleman who had given 27 inches for the amount of the fall at Durban was dead when I arrived in the colony the year after the flood, and I found the instruments he had used in so dilapidated and disorderly a condition, that I am not able to place implicit reliance upon the record. I confess that I quite discredited the estimate of the amount of the fall until I had had my own personal experience of the coast rainfall, without flood, in June 1865; since that time I have been of opinion that the record for the fall of the coast flood, in 1856, was most probably not far from accurate.

Floods of this violent description are, however, obviously of very rare occurrence in Natal; no other has been experienced within the period of civilized occupation of the country.

As a general rule, the coast rainfall seems to be about as much again as the rainfall at the elevation of Maritzburg. One careful experiment which I was able to institute for a period of six months, the last months, namely, of the year 1865, gave the following results:—

	Maritzburg. inches.		Durban. inches.
July	0·10	.....	0·48
August	1·26	.....	3·82
September	2·44	.....	7·41
October	0·93	.....	0·59
November	3·18	.....	6·07
December	3·84	.....	4·22
Total	11·75	.....	22·59

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XVI. *Influence of the Sun's Hour-angle on the Development of Ozone.* By R. C. C. LIPPINCOTT, Esq., F.M.S.

ONCE in every week during twenty-four hours, from August 31st, 1856, to December 31st, 1857, hourly observations of the amount of ozone present in the atmosphere were made at the Royal Observatory, Greenwich*.

From these observations it is evident that the earth's position with regard to the sun has a marked influence on the amount of ozone developed.

This influence has not, so far as I know, been investigated: the following Tables and remarks may therefore prove interesting as tending to throw light on the cause of the formation of atmospheric ozone, and of the variations in the amount developed.

Table I. gives the amount of ozone registered each hour during twenty-four hours once in every week in the year 1857.

Table II. gives the amount registered hourly during twenty-four hours once in every week, from August 31st to December 31, 1856.

* Greenwich Observations, 1856, pp. clxvi-clxxxii; 1857, pp. clxvi-ccx.

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TABLE I. Showing the amount of Ozone registered each Hour

Month and Day.	Hours.											
	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
January 4.....	2	2	3	4	4	5	5	5	5	8	0	2
„ 11.....	0	0	0	0	0	1	3	3	0	0	0	0
„ 18.....	0	0	0	0	0	10	10	10	10	0	0	0
„ 25.....	10	10	8	4	1	1	0	0	0	0	0	0
February 1 ...	0	0	0	0	0	0	0	2	3	4	0	0
„ 8 ...	9	10	10	10	10	10	10	10	10	10	0	0
„ 15 ...	2	2	1	1	0	0	0	0	0	0	0	0
„ 22 ...	1	1	2	3	4	0	0	0	0	0	0	0
March 1	6	6	7	7	7	7	7	7	7	7	0	1
„ 8	0	0	0	0	0	0	0	0	0	0	0	0
„ 15	1	1	1	1	1	2	2	2	2	2	0	0
„ 22	0	0	0	0	0	0	0	3	5	3	0	0
„ 29	0	0	0	0	0	0	1	2	6	9	1	3
April 5	1	1	2	2	2	3	5	6	7	10	0	0
„ 12	7	8	8	9	9	9	10	10	10	9	0	0
„ 19	0	0	0	0	0	0	0	2	1	2	0	0
„ 26	0	0	0	0	0	0	0	0	0	0	0	0
May 3	0	0	0	0	2	2	2	3	5	7	0	0
„ 10	0	0	0	3	8	8	8	9	10	9	0	0
„ 17	0	0	0	0	0	2	2	3	0	5	0	0
„ 24	0	0	0	0	1	1	2	2	2	0	1	1
„ 31	0	0	0	0	2	3	3	4	5	6	0	0
June 7	0	2	2	2	2	2	3	3	3	2	0	0
„ 14	0	0	0	4	4	4	6	8	8	0	0	0
„ 21	8	8	9	10	10	10	10	8	8	10	2	0
„ 28	0	0	0	0	0	0	2	1	0	3	0	0
July 5	0	0	3	6	7	8	9	10	10	10	0	0
„ 12	0	0	0	0	3	3	3	3	2	2	0	0
„ 19	3	3	4	5	5	5	6	6	6	6	0	0
„ 26	0	0	0	3	4	7	10	10	10	10	0	0
August 2	0	0	0	0	0	0	0	0	3	3	0	0
„ 9	0	0	0	0	0	0	0	0	0	0	0	0
„ 16	0	8	8	9	10	10	10	10	10	10	0	0
„ 23	0	0	0	0	0	2	4	6	9	8	0	0
„ 30	0	0	0	0	0	0	0	0	0	0	0	0
September 6...	3	3	3	4	4	5	8	10	10	10	0	0
„ 13...	4	5	5	6	8	9	9	10	10	10	2	4
„ 27...	8	8	9	9	10	10	10	10	10	0	0	0
October 4.....	0	0	0	0	0	0	0	0	0	0	0	0
„ 11.....	0	0	0	0	0	0	0	0	0	0	0	0
„ 18.....	5	6	6	6	7	7	7	8	8	6	0	0
„ 25.....	0	0	0	0	0	0	0	0	0	0	0	0
November 1...	3	4	4	4	5	6	7	8	8	10	0	0
„ 8...	0	0	0	0	0	0	0	0	0	0	0	0
„ 15...	5	5	6	6	7	7	7	7	7	8	0	0
„ 22...	3	4	4	4	4	5	6	8	10	10	0	0
„ 29...	0	0	0	2	3	4	5	6	6	4	0	0
December 6...	10	10	10	10	10	10	10	10	10	10	10	10
„ 13...	0	0	0	0	2	3	3	4	5	0	0	0
„ 20...	3	3	4	4	4	4	5	6	8	4	0	0
„ 27...	0	0	0	0	0	0	0	0	0	0	0	0
Sums	94	110	119	138	160	185	210	235	249	227	16	21

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during Twenty-four Hours once in every Week in the Year 1857.

Month and Day.	Hours.											
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
January 5.....	3	4	4	5	5	5	3	3	3	0	0	0
„ 12.....	0	1	2	2	3	0	0	0	0	0	0	0
„ 19.....	0	0	0	0	0	0	0	0	0	0	0	0
„ 26.....	0	0	0	0	0	0	0	0	0	0	0	0
February 2 ...	2	2	4	6	7	8	8	10	10	10	0	0
„ 9 ...	1	2	2	2	2	2	3	3	5	8	10	10
„ 16 ...	0	0	0	0	0	0	0	0	0	0	0	0
„ 23 ...	0	0	0	0	0	0	0	0	0	0	0	0
March 2	3	3	4	4	4	4	4	4	4	4	0	0
„ 9	0	0	0	0	0	0	0	0	0	0	0	0
„ 16	0	0	0	0	0	0	0	0	0	0	0	0
„ 23	0	0	0	0	0	0	0	0	0	0	0	0
„ 30	3	3	3	3	3	3	3	5	5	10	4	5
April 6.....	2	2	2	2	2	0	0	0	0	0	0	0
„ 13.....	0	0	0	0	0	0	0	0	0	0	0	0
„ 20.....	0	0	0	0	0	0	0	0	0	0	0	0
„ 27.....	0	0	0	0	0	0	0	0	0	0	0	0
May 4	0	0	0	0	0	0	0	0	0	0	0	0
„ 11	1	1	2	2	2	2	2	2	2	0	0	0
„ 18	0	0	0	0	0	0	0	0	0	0	0	0
„ 25	1	1	1	2	2	2	3	4	4	5	5	5
June 1	0	0	0	0	0	0	0	0	0	0	0	0
„ 8	0	0	0	0	1	1	3	3	6	8	8	9
„ 15	0	0	0	0	0	0	0	0	0	0	0	0
„ 22	0	0	0	0	0	0	0	0	0	2	2	2
„ 29	0	0	0	0	0	0	0	0	0	0	0	0
July 6	0	0	0	0	0	0	0	0	0	0	0	0
„ 13	0	0	0	0	0	0	0	0	0	0	0	0
„ 20	3	4	5	5	6	6	6	5	5	5	0	0
„ 27	0	0	0	0	0	0	0	0	0	0	0	0
August 3	0	0	0	0	0	0	0	0	0	0	0	0
„ 10	0	0	0	0	0	0	0	0	0	0	0	0
„ 17	0	0	0	0	0	0	0	0	0	0	0	0
„ 24	0	0	0	0	0	0	0	0	0	0	0	0
„ 31	0	0	0	1	2	2	2	2	2	2	2	2
September 7...	2	2	3	4	5	6	6	5	7	7	0	0
„ 14...	6	6	5	6	6	6	6	6	8	8	0	0
„ 28...	0	0	0	0	0	0	0	0	0	0	0	0
October 5.....	0	0	0	0	0	0	0	0	0	0	0	0
„ 12.....	3	3	4	4	2	1	0	0	0	0	0	0
„ 19.....	0	0	0	0	1	2	2	2	2	2	2	2
„ 26.....	0	3	4	4	4	4	4	5	3	3	3	3
November 2...	0	0	0	0	0	0	0	0	0	0	0	0
„ 9...	0	0	0	0	0	0	0	0	0	0	0	0
„ 16...	0	0	0	0	0	0	0	0	0	0	0	0
„ 23...	0	0	0	0	0	0	0	0	0	0	0	0
„ 30...	1	1	3	3	3	2	2	2	3	3	5	5
December 7 ...	5	6	6	6	6	6	5	5	5	5	5	6
„ 14 ...	5	5	6	6	6	6	6	6	6	5	5	5
„ 21 ...	0	0	0	0	0	0	0	0	0	0	0	0
„ 28 ...	0	0	0	0	0	0	0	0	0	0	0	0
Sums	41	49	60	67	72	68	68	72	80	87	51	54

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TABLE II. Showing the amount of Ozone registered each Hour during Twenty-four Hours once a Week from August 31 to December 31, 1856.

Month and Day.	Hours.											
	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
August 31	0	0	0	0	0	0	4	2	0	0	0	2
September 7...	0	0	0	0	0	0	2	0	0	0	0	0
,, 14...	0	0	1	2	4	5	7	7	7	6	2	3
,, 21...	10	10	10	10	10	10	10	10	7	10	0	1
,, 28...	6	8	9	9	10	10	10	10	10	10	0	0
October 5.....	7	8	8	8	8	8	8	8	8	6	0	0
,, 12.....	0	0	0	0	0	0	0	0	0	0	0	0
,, 19.....	5	5	5	5	6	7	7	8	8	9	0	0
,, 26.....	3	5	5	5	5	5	6	7	8	5	0	0
November 2...	4	5	6	7	8	8	8	6	1	1	0	0
,, 9...	0	0	0	0	0	0	0	0	0	0	0	0
,, 16...	0	0	0	0	0	0	2	0	0	0	0	0
,, 23...	0	0	0	0	0	0	0	0	0	0	0	0
,, 30...	0	0	0	0	0	0	0	0	0	0	0	0
December 7...	0	0	0	0	1	1	2	2	2	2	2	2
,, 14...	0	0	0	0	0	0	0	0	0	0	0	0
,, 21...	0	0	0	0	0	0	0	0	0	0	0	0
,, 28...	0	0	0	0	0	0	0	0	0	0	0	0
Sums	35	41	44	46	52	54	66	60	51	49	4	8

Month and Day.	Hours.											
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
September 1...	0	0	1	1	1	1	1	2	2	2	2	2
,, 8...	0	0	0	1	3	6	4	0	0	0	0	0
,, 15...	2	1	6	8	9	9	9	6	0	0	3	4
,, 22...	3	4	6	9	10	10	10	10	10	10	0	0
,, 29...	0	0	0	0	0	0	0	0	0	0	0	0
October 6.....	0	0	0	0	0	0	0	0	6	9	5	9
,, 13.....	3	4	4	4	4	5	5	10	10	8	1	3
,, 20.....	3	0	0	0	0	3	3	4	6	7	9	9
,, 27.....	1	2	2	2	6	6	6	3	0	0	0	0
November 3...	3	6	6	5	6	6	5	4	0	0	0	0
,, 10...	0	0	0	0	0	0	0	0	0	0	0	0
,, 17...	0	0	0	0	0	0	0	0	0	0	0	0
,, 24...	0	0	0	0	0	0	0	0	0	0	0	0
December 1...	0	0	0	0	0	0	0	0	0	0	0	0
,, 8...	2	2	2	2	3	3	2	2	5	5	5	5
,, 15...	0	0	0	0	0	0	0	0	0	0	0	0
,, 22...	0	0	0	0	0	0	0	0	0	0	0	0
,, 29...	0	0	0	0	0	0	0	0	0	0	0	0
Sums	17	19	27	32	42	49	45	41	39	41	25	32

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By dividing the sums under each hour in Table I. by the number of observations, the mean amount of ozone for each of the twenty-four hours, once a week, during the year 1857, is obtained:—

Mean	amount	of	ozone	for hour 12=1·84
,,	,,	,,	,,	13=2·15
,,	,,	,,	,,	14=2·33
,,	,,	,,	,,	15=2·70
,,	,,	,,	,,	16=3·13
,,	,,	,,	,,	17=3·62
,,	,,	,,	,,	18=4·11
,,	,,	,,	,,	19=4·60
,,	,,	,,	,,	20=4·88
,,	,,	,,	,,	21=4·45
,,	,,	,,	,,	22=0·31
,,	,,	,,	,,	23=0·41
,,	,,	,,	,,	0=0·80
,,	,,	,,	,,	1=0·96
,,	,,	,,	,,	2=1·17
,,	,,	,,	,,	3=1·31
,,	,,	,,	,,	4=1·41
,,	,,	,,	,,	5=1·33
,,	,,	,,	,,	6=1·33
,,	,,	,,	,,	7=1·41
,,	,,	,,	,,	8=1·56
,,	,,	,,	,,	9=1·70
,,	,,	,,	,,	10=1·00
,,	,,	,,	,,	11=1·05

From this it is evident—

1. That a well-marked period of *maximum* development of ozone occurs between 16^h and 21^h, and an equally well-marked period of *minimum* development between 22^h and 1^h.

2. That there is a *tendency* to a second period of *maximum* development between 4^h and 9^h, and to a second period of *minimum* development between 10^h and 12^h.

3. That the amount of ozone developed between 12^h and 21^h is *more than double* of that developed between 22^h and 11^h.

Again, by dividing the sums under each hour in Table II. (which is better kept separate from Table I., because it gives only part of a year), the mean amount of ozone for each of the twenty-four hours, from August 31 to December 31, 1856, is obtained:—

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Mean amount of ozone for hour				12=1·94
,,	,,	,,	,,	13=2·27
,,	,,	,,	,,	14=2·44
,,	,,	,,	,,	15=2·55
,,	,,	,,	,,	16=2·88
,,	,,	,,	,,	17=3·00
,,	,,	,,	,,	18=3·66
,,	,,	,,	,,	19=3·33
,,	,,	,,	,,	20=2·83
,,	,,	,,	,,	21=2·72
,,	,,	,,	,,	22=0·22
,,	,,	,,	,,	23=0·44
,,	,,	,,	,,	0=0·94
,,	,,	,,	,,	1=1·05
,,	,,	,,	,,	2=1·50
,,	,,	,,	,,	3=1·77
,,	,,	,,	,,	4=2·33
,,	,,	,,	,,	5=2·72
,,	,,	,,	,,	6=2·50
,,	,,	,,	,,	7=2·27
,,	,,	,,	,,	8=2·16
,,	,,	,,	,,	9=2·27
,,	,,	,,	,,	10=1·38
,,	,,	,,	,,	11=1·77

Here again we find—

1. A well-marked period of *maximum* development occurring between 16^h and 21^h, and an equally well-marked period of *minimum* development between 22^h and 1^h.

2. A strongly-marked *tendency* to a second *maximum* between 4^h and 9^h, and to a second *minimum* between 10^h and 12^h.

3. That the amount of ozone developed between 12^h and 21^h is *considerably greater* than the amount developed between 22^h and 11^h.

Comparing the deductions from both the Tables, we find:—

I. That the *maximum* development of ozone takes place when the sun is near the *eastern horizon*; and that there is a tendency to a second *maximum* when the sun is near the *western horizon*.

II. That the *minimum* development of ozone occurs when the sun is near the zenith; and that there is a tendency to a second *minimum* when the sun is near the *nadir*.

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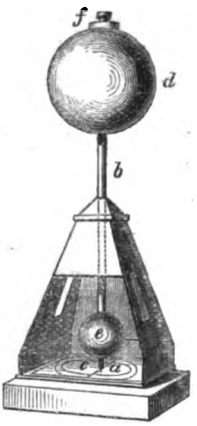
XVII. *On a Self-recording Anemometer.*

By S. B. Howlett, Esq.

It is well known that there is no instrument, of a portable kind, before the public that will register the direction and force of the wind; but it is hoped that this want will be met by the Anemograph, which records the action of the air in the form of a map.

Fig. 1 is a view of the instrument ready to be fixed on any convenient support which commands the horizon.

Fig. 1.



a. The base of the instrument is a slate, 12 inches square and an inch thick, on which is engraved a circle 10 inches in diameter, divided into degrees, and figured from 0 to 360; upon this base is fixed a square pyramid made of zinc, having a window on each side, and closed by a shutter.

b. A brass tube, forming a lever, working in a gimbal as a fulcrum in the top of the pyramid.

c. A pencil or tracer, of a proper weight, working freely in the brass tube.

d. A sphere 8·56 inches in diameter, that being the size of a sphere upon whose hemisphere the wind will press one-fifth of a square foot; so that if the sphere be drawn back by 1 lb., the deflection of the pencil *c* will represent a pressure of 5 lbs. on a square foot.

e. A weight so adjusted with reference to the sphere as to cause the pencil to express pounds of pressure on the square foot

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by its distance from the centre of the graduated circle, according as the sphere is down, up, or up with a weight *f* at the top, thus giving three scales.

When the sphere is down, the scale of pressure is 0 to 20 lbs. on the square foot; when up, the scale is 0 to 5 lbs.; and when up with the weight *f* on, the scale is 0 to 2½ lbs. A wooden measure graduated to these three scales, by actual trials, is attached to the instrument.

For ordinary registers, kept daily, all the year round, the sphere should be always down without the weight *f*. The other two scales are for experiments, under personal superintendence, on light winds, which have never yet, it is believed, been investigated for want of an instrument that will give correct results. Some persons, however, prefer a pressure of 25 lbs., and dispense with the other scales.

In action, the pencil throws out from the centre, or zero, a line in the direction the wind comes from, and, in returning, a loop or curved line is formed, and the force of the wind is indicated by the length of the line or loop; so that by laying the wooden scale against the centre of the slate and the end of the loop, the force is read on the edge in pounds' pressure on the square foot, and the angle at which the current of air crossed the meridian is at the same time found in degrees on the divided circle.

The greatest pressure here provided for is 20 lbs. on the square foot, which is sufficient for the winds that occur in this country, as proved by careful experiments.

This instrument is strong enough to bear any hurricane; and to measure any force above 20 lbs., nothing more is necessary than to increase the weight marked *e*, in fig. 1, in a certain proportion.

Fig. 2 shows the square slate upon which the instrument works. The part in black represents the manner in which either a breeze or a storm is recorded, the salient points of which mark the direction and force of the principal currents, which are to be measured by applying the proper scale as before directed.

But these black markings show a remarkable fact which this instrument offers to our contemplation, and which no other instrument has the power of showing. If, while the wind is blowing, the pencil be held on the centre of the slate, and then let go for a few seconds only, we get a figure consisting of several loops, as shown by the dark lines; from which, probably, no other conclusion can be drawn, than that the wind moves on in circles which are constantly

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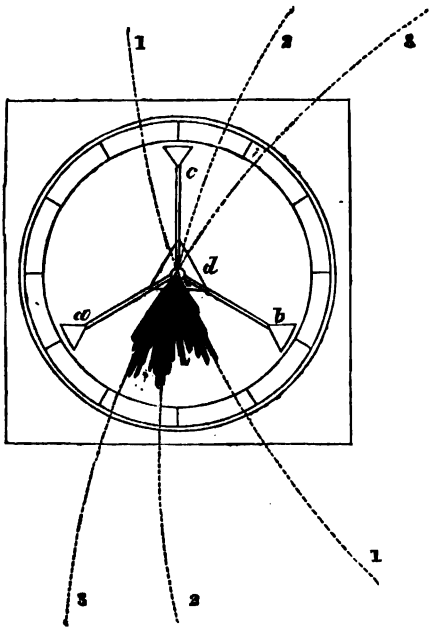
crossing the paths of each other, as shown by the lines 1, 2, and 3. It appears almost certain that if a sufficient number of these instruments were employed in positions accurately marked on a map, and the times of the observations noted, the courses of these circles and their diameters might be laid down on a map, and so, by studying the small circles of a whirling breeze, a better knowledge of the law of storms could no doubt be obtained.

Fig. 2.



In this figure is shown a contrivance by which the oscillation of the weight is prevented: *a*, *b*, *c* are three arms running upon wheels, and working on a brass centre-pin that drops through a hole in the middle of the slate; *d* is an india-rubber band stretched on three hooks on the tops of the arms, forming a spring against which the returning pencil strikes back to the centre.

Maps on common paper may be drawn by the instrument either with black-lead pencil or blue-chalk pencil; or they may be made on common paper by an agate tracing-point working on carbon paper.

The observer, therefore, can take his choice, either to look at the work on the slate, as done with the slate-pencil, and then rub

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it out, or to obtain daily maps on paper, which would show in a striking manner the action of the air throughout the year; and the instrument also gives the power of trying experiments that it is hoped will some day lead to important discoveries.

When paper is used, it is necessary to make a small cross cut in the centre of the paper through which to pass the brass centre-pin before referred to.

Of course the zinc cover of the instrument might be extended in such a way as to give shelter to the observer.

In fixing the instrument, of course the door must be put into a position where it may easily be got at; and then, if the meridian on the slate cannot be placed accurately on the true meridian of the station, that meridian must be drawn on the slate, to which all the observations must be referred. In giving an order, instructions as to the meridian line should be stated. Provided the variation of the needle be accurately allowed for, the instrument may be readily placed on the meridian by means of a good square box-compass.

The principal novelty of this instrument is, that a sphere is used instead of a flat pressure-plate. The great circle of this sphere is the pressure-plate, with the advantage of having the back of it guarded by a hemisphere, which prevents the formation of a vacuum by eddies. There will be, however, a small vacuum at the back of the sphere, the effect of which in light winds is not worth notice; and in a gale the pressure would not, perhaps, be exaggerated more than a pound per square foot.

This being a new instrument, it has not received those improvements which might have resulted from public discussion. One, however, has been in daily use for a twelvemonth, by a gentleman in Dorset Square, who speaks of the instrument in very favourable terms.

Notes on the Weather, January to March.

Osborne (J. R. Mann, Esq.).—A meteor was seen about daylight on the morning of the 1st of January in the east; altitude about 30°, horizontal length of path 70°. The cloud or vapour left behind was discernible, by some accounts, for two hours after the disappearance of the meteor. This station was visited by a succession of gales of wind on the 17th, 18th, 19th, and 22nd, the

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maximum pressure being 20 lbs. on the square foot, at 1 P.M. of the 18th.

SIDMOUTH (J. Ingleby Mackenzie, Esq., M.B.), February.—A severe hailstorm occurred at 6.30 P.M. on the 22nd, lasting about twenty minutes, the hailstones were of the size of small marbles; two were weighed—one, about the average size, weighed 7, the largest found, 9 grains.

BOURNEMOUTH (W. S. Falls, Esq.).—At 11.30 P.M. of the 21st of January, a most severe and unusual thunderstorm took place, which lasted until 1 A.M. of the 22nd.

BOURNEMOUTH (T. A. Compton, Esq.), January.—Mean temperature of the earth at 2½ feet below the surface 40°·4; maximum 43°, minimum 38°·2. The thermometer is imbedded in gravel, which stratum here begins at from 1½ ft. to 2 ft. below the surface, and is about 4 ft. thick; below is sand. Remarkable fluctuations of the atmospheric pressure took place between the 17th and 22nd days. After 7 P.M. of the 17th, the barometer reading rose rapidly, and reached 29·98 ins. at 11 P.M., when it again began to fall. At noon of the 18th it was 29·42 ins., at 4 P.M. 29·21 ins., falling, at 8 P.M. 29·12 ins., 10 P.M. 29·04 ins., thus falling steadily throughout the afternoon and evening till 11 P.M., when it remained steady; by 10 A.M. of the 19th it rose to 29·18 ins., but fell to 29·16 ins. by 1 P.M. of the same day. At 10 A.M. of the 20th it was 29·08 ins., rising rapidly all day, and rose to 29·71 ins. by 10 A.M. of the 21st; it then began to fall, and at 2 P.M. of the 22nd it had fallen to 29·01 ins.; it then commenced to rise, and by 10 A.M. of the 24th the reading was 30·34 ins.

February.—The following are the readings of four thermometers, placed at different depths below the surface of the ground, read at 10 A.M. daily:—

Depth. ft.	ins.	Mean temp.	Highest temp.	Lowest temp.
1	0	42°·0	45°·0	39°·3
2	6	42·6	44·3	41·5
3	6	42·8	44·0	42·2
5	0	43·2	44·0	42·7

March.—The following are the observations:—

Depth ft.	ins.	Mean temp.	Highest temp.	Lowest temp.
1	0	43°·5	46°·6	39°·6
2	6	44·5	45·4	43·5
3	6	44·6	45·0	44·0

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TAUNTON (Rev. W. Tuckwell).—January was a mild dull month. Heavy gales on the 17th and 25th. Smart shock of earthquake at 5h 20m A.M. of the 4th. Lambs seen on the 1st.

February was a fine dry month, vegetation unusually forward, abundance of ozone.

March.—The month opened dull and boisterous and ended with a succession of lovely dry warm days. The season is unusually forward; the flowers usually not due till April were in bloom early in the month, and the trees and hedges are three weeks in advance of last year.

STRATHFIELD TURGISS (Rev. C. H. Griffith, M.A.), January.—The first part of the month being frosty, it was favourable for carting manure upon the land. Since the break up of the frost on the 8th, the slugs have come forth from their hiding-places and done considerable damage to the young wheat. On the 18th a strong gale visited this station from the S.W. Barometer at 9.30 P.M. stood at 28·72 ins.; the River Loddon greatly overflowed its banks. During the latter part of the month sheep were losing instead of gaining flesh, and treading their food into the dirt. No lack of food for the flock: turnips not rotted by the frost, having been protected by the snow. Upward price of wheat will probably continue, as the stock in hand is below the average for the time of year, and weather unsuitable for thrashing. Labourers in general are tolerably well employed.

February.—The temperature of the month having been much above the average, the young wheat, though late sown, is as forward as usual. The dryness of the month has been favourable for the sowing of the various pulse crops, now nearly completed. If we have no very heavy rains and sharp frosts, there will be heavy grass-crops; the young clover is good and thick, and a good yield of hay is promised. Food for sheep is abundant. Last year's clover-seed thrashes out less per acre than was expected, the seed being small. No lack of employment for labourers.

The month of March was very favourable for agricultural operations, the greater part of the barley and oats sown.

MARLBOROUGH COLLEGE (Rev. Thos. Preston, M.A.), February.—Plants very forward: gooseberries and currant-trees green in very warm spots, apricots and other wall-fruit in full bud by the end of the month, hawthorn putting forth young leaves.

ENSLEIGH LANSDOWNE (C. H. Weston, Esq., B.A.).—On the 11th of January this station was visited by another of those rare

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occurrences of *ice-rain*, which have been witnessed in Bath only three times in twenty-two years, evidently resulting from a warm upper southerly current saturated with moisture of a temperature considerably above the lower current, coming in contact with a N.E. wind, which had been blowing before the fall took place.

Streatly Vicarage (Rev. J. Slatter, M.A.).—From the 1st to the 6th of January slight falls of snow took place every day, ending with a fall of 2 inches on the 6th, which immediately melted. The Rev. J. Slatter says, alluding to the ice-fall, "this was the day (10th) on which fell what the correspondent of a paper called 'the ice-shower on the Chilterns.' It was truly as follows:—1. Snow, which was ready to melt, fell and adhered to the frozen branches. 2. The snow gradually turned to rain, which destroyed the snow-crystals, whilst the frozen trees turned the neap twice; everything was coated with ice. I brought in perfect tubes of ice which had formed on my radiating thermometers." The maximum and minimum readings of the barometer were taken, the former at 11^h P.M. of the 28th, and the latter at $11^h 30^m$ P.M. of the 18th, the range being 1·399 in. A furious gale raged with great violence from the 31st to February 2nd at 2 P.M.

Wisbech (S. H. Miller, Esq.), March.—Vegetation very forward at the end of the month. Gale of wind on the 8th; greatest pressure 14 lbs. on the square foot.

Holkham (John Davidson, Esq.), March.—A lunar halo was seen at this station on the evening of the 6th: the clouds around the moon assumed the colours of the rainbow, presenting a very beautiful appearance for about a quarter of an hour, when the colours were dissipated, leaving simply a dark halo (bright moonlight); first noticed about 11 o'clock.

Eccles (Thos. Mackereth, Esq.).—Of the storm of the 1st of February, Mr. Mackereth writes:—"My present anemometer is 34 feet from the ground, and the maximum pressure recorded by it on Saturday the 1st was 31 lbs. on the square foot. This is the heaviest storm that has visited this neighbourhood since I have resided in it, now nearly eight years. The damage done to buildings in course of erection, roofs, chimneys, and fences has been immense. The heaviest part of the storm began, as the barometer reached its lowest reading, at 9 A.M., viz. 28·923 ins., and lasted eight hours.

Liverpool (John Hartnup, Esq.).—On the 31st of January this station was visited by a gale of wind from the S.W. Maxi-

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mum pressure 51 lbs. on the square foot at 11h 30m P.M. From 4h to 11h on the morning of February 1st, the gale moderated to occasional pressures of from 20 lbs. to 30 lbs.

At 11h 20m A.M. a hurricane commenced suddenly. From 11 A.M. to 3 P.M. the mean hourly velocity of the wind registered by the anemometer was 87 miles; but there were short intervals between 11.30 A.M. and 12.30 P.M. during which the velocity was at the rate of from 100 to 120 miles per hour. From 11.20 A.M. to 2.40 P.M. pressures were recorded, almost continuously, by the anemometer of from 50 lbs. to 70 lbs. on the square foot, the latter being the maximum capable of being recorded by the instrument; from midnight on the 31st of January to midnight on the 1st of February, 1500 miles of air passed over the Observatory. The lowest reading of the barometer was 28·98 ins. at noon of the 1st, the direction of the wind being W.S.W., and at this time the hurricane was at its height.

No gale of wind having any comparison to this in violence has been recorded at this Observatory since the erection of the anemometer.

Cockermouth (H. Dodgson, Esq., M.D.), January.—A gale from S.W. to W.S.W. on the 18th. Barometer fell all day till 4 P.M., when the uncorrected reading was 28·362 ins. (or 28·494 ins. corrected and reduced to 32° at sea-level). High wind (amounting to a gale) on the 24th, *strongest in the afternoon and early part of the evening*. Barometer lowest at 6 P.M. =29·221, or 0·617 lower than at 9 A.M. on the same day. Another gale (from S.W.) occurred on the afternoon and evening of the 31st, at 11 P.M. barometer reading 28·932 ins., and still falling. During these gales considerable damage occurred to shipping in the Solway Firth, several vessels being wrecked or blown on shore. Little damage to trees and buildings in this neighbourhood.

February.—A month of rainy unsettled weather, very similar to that of February 1867. Frost (at 4 feet above the ground) only on two nights during the month. High S.W. winds prevailed and (as a consequence) ozone was very abundant. Mean temperature of the month 3°·6 in excess of the average of the last six years. The lowest reading of the barometer was on the 1st, at 11.30 A.M., =28·628 ins. (uncorrected).

March.—A month of mild weather, scarcely any frost. Mean temperature of the month 3°·9 above the average of the last six years. Since January 1st, 1868 (to the end of the quarter) 18·58 ins. of rain have fallen, whilst only 9·15 ins. fell during the first quarter

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of 1867. Vegetation very forward, two or three weeks earlier than last year.

Silloth (Rev. F. Redford, M.A.).—The weather throughout the whole of the past quarter has been the most stormy and unsettled ever observed here. The absence of east winds is noteworthy, as well as the great amount of ozone.

Bywell (Thos. Sopwith, Esq., M.A.), February.—High winds have prevailed during the greater part of the month. Since the first week, the weather has been all that the farmer could desire for getting the land in order for spring sowing. Most of the seed is now in the ground. Vegetation is too far advanced for the season.

March.—Vegetation has made progress during the month. Autumn-sown corn is looking well. Berry-bearing bushes are healthy, and fruit-buds are bursting in every direction. The land is working very lumpy for want of rain.

Miltown (John Smyth, Esq., M.A.), February.—The high winds and showery weather retarded bleaching-operations very much, as the linens could not be kept properly spread, and were seldom carried in from the field dry. The absence of frost, which favours bleaching by expanding and opening the threads of the linen, was also injurious to bleaching.

Culloden (A. Forbes, Esq.), February.—The month of February was in many respects a remarkable one, and likely to be remembered. January disappeared with a tremendous gale from S.S.W. to S.W. accompanied with drenching rain which flooded rivers to a greater extent than has been the case for nineteen years, resulting, in many instances, in great destruction of property, bridges, and river embankments. The 1st, 4th, 5th, 6th, 7th, 20th, and 21st days and nights were particularly boisterous, with heavy gales from the southward, much rain and sleet falling, with lightning at nights; on the 5th and 7th the pressure of the wind on the square foot ranged from 17 lbs. to 24·5 lbs. The lowest reading of the barometer (28·276 ins.) was taken on the 1st; between that day and the 6th, it greatly fluctuated under 29·927 ins.; and all through the month the barometrical column was more or less subject to considerable and rapid oscillations. The mean temperature (40°·85) was high for the month. The maximum reading in the shade (54°·9) was taken on the 26th, and the lowest (31°·4) on the 4th. The thermometer on the grass indicated a few degrees of frost on thirteen nights; but to

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so small an extent that vegetation received no check. The rainfall, 3·882 ins., was over the monthly average, and has rendered the land in many districts very wet and quite unworkable. The constant succession of such violent storms has been severely felt by sheep and stock in exposed situations: the only thing by any means favourable to them has been the continued absence of snow; and consequently pasture, however bad and scanty, was always to be had. The wheat-crops look well, everywhere healthy and very vigourous; stock in general have done well and thriven steadily during the winter months. Turnips are getting scarce; but, as the grass season promises to be an early one, this scarcity will not be felt so severely.

Culloden, March.—The past month has been a fine one; and consequently, throughout the northern districts generally, agricultural labour is far advanced. The continued prevalence of westerly winds, and the absence of frost, have both been remarkable features, and have tended to raise the mean temperature several degrees above the average, and cause vegetation to progress rapidly. The highest barometrical reading, 30·400 ins., was taken on the 28th, and the lowest, 28·439 ins., on the 9th. The highest temperature in the shade, 58°·1, was recorded on the 13th; the lowest, 30°·3, on the 24th. The greatest fall of temperature on the earth's surface was observed on the 24th, when the thermometer on the grass stood at 22°·6, thus registering 9°·4 of frost. Oat- and rye-sowing commenced in the lower districts from the 16th to the 20th, and was vigorously prosecuted up to the end of the month, leaving at that date, excepting on upper and colder lands, very little breadth unsown. The wheat-crop is looking well everywhere, having a very thick braid with a fine healthy appearance. Young grass and, in fact, all pastures are coming up very quickly, and give every promise of being earlier than for several seasons. The crop of lambs in the district is generally very good, few deaths taking place; the weather being very favourable and the pasture early, are much in their favour. Store cattle are bringing good prices, leaving something for their keep; and when in forward condition and ready for the market, 60*s*. to 70*s*. a cwt. is easily obtained for them. Potatoes have fallen considerably in value; but the grain-markets are well supported, prices ruling high, and in favour of the seller.

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PROCEEDINGS

OF

THE METEOROLOGICAL SOCIETY.

EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

1868, JUNE 17.

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Vol. IV. 1868, JUNE 17. [No. 38.

JAMES GLAISHER, Esq., F.R.S. &c., President, in the Chair.

Rev. Charles John Steward, Somerleyton Rectory, Lowestoft;
W. J. Trentler, Esq., M.D., Kew Green, W.;
were balloted for and duly elected Fellows of the Society.

XVIII. *On the Rainfall of Mauritius.* By Charles Meldrum, Esq., M.A., F.M.S., Director of the Mauritius Observatory.

I have the honour to lay before the Society the accompanying Tables exhibiting the results of observations on the rainfall at twenty-four stations in the Island of Mauritius.

Table I. shows the monthly and annual rainfall at the Royal Engineers' station at Port Louis, on the ground, from 1853 to 1858; and Table II. the rainfall at the Observatory, about 400 yards east of the former station, and at 40 feet above the ground, from 1859 to 1866. The next five Tables (III. to VII.) give the results obtained at twenty-four stations for various periods. Table VIII. shows the mean monthly and mean annual fall, and

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Table IX. the fall for each year, at nine of these stations for five years (1862–66).

General Description of the Island.—Mauritius is situated nearly between 20° and 21° S. lat. and 57° and 58° E. long. It is somewhat oval or pear-shaped, its northern being narrower than its southern extremity, and its greatest length from north to south being thirty-five miles, whilst its greatest width from east to west is twenty-nine miles. From its most northern to its most southern point the distance is thirty-nine miles, and from its most eastern to its most western point thirty-five miles. It has a superficies of about 720 square miles, and is divided into nine Districts, viz. *Rivière du Rempart* and *Pamplemousses*, extending from coast to coast in the north; *Port Louis*, on the west coast, south of Pamplemousses; *Flacq*, on the east coast, south of Rivière du Rempart; *Moka* and *Plaines Wilhelms*, the former lying wholly, and the latter almost wholly, in the interior; *Black River*, on the west coast, west of Plaines Wilhelms; *Grand Port*, on the east and south-east coasts; and *Savanne*, on the south coast.

The principal feature in the conformation of the island is, that it consists of a central tableland, which is separated from the plains on and near the coast, in some places by lofty mountain-chains, in others by steep precipices, and in others by more gradual, but still rapid, descents. This tableland comprises nearly the whole of Moka and Plaines Wilhelms, together with the more inland parts of Flacq, Grand Port, Savanne, and Black River. Its central ridge, which is the principal watershed of the island, extends, in an east-by-north direction, from the Savanne mountains in the south to the northern limits of Moka, over a distance of about twenty miles, and, like the tableland itself, is most elevated in its southern half. From this ridge the ground slopes on either side, forming here and there, at heights of 700 to 1400 feet above the sea-level, extensive and almost level plains, which, in some places, are abruptly separated from the littoral plains, several hundreds of feet below them, by almost perpendicular cliffs. The more gradual ascent, in the intervals between the mountains, commences at short distances from the sea, and continues up to heights of 1200 to 1800 feet, from which there is a similar descent to the opposite coast. The railway from Port Louis, on the west, to Mahébourg, on the east coast, crosses the tableland in a S.E. and N.W. direction; and the heights of the stations, determined by levelling, show the ascent and descent in

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that part of the island. Thus, at four miles from Port Louis, the elevation is 392 feet, at eight miles 923 feet, at eleven miles 1311 feet, and at sixteen miles, or about halfway, 1822 feet; the line then descends to 1000 feet at twelve miles, 559 feet at seven miles, and 253 feet at five miles from Mahébourg. Generally, however, the tableland is separated from the littoral plains, or the sea, by mountains, of which there are three groups, viz.:—

(1) The Port-Louis group in the north-west, the central line of which runs about twelve miles in an east-by-north direction, at four to eight miles from the sea, and which ranges from 1000 to 2900 feet in height.

(2.) The Black-River and Savanne group, consisting of a series of mountains and elevated ridges, from 1000 to 3000 feet above the sea-level, stretching irregularly about twenty miles to the southward, along the west coast, and then about fourteen miles along the south coast, the greatest distance from the sea not exceeding six miles, while in many places the bases of the mountains or steep cliffs are close to the shore.

(3) The Grand-Port and Flacq group, in the south-east and east, rising to the height of 1200 to 2400 feet, and consisting of three main chains running nearly parallel to one another in a westerly direction, the principal chain being about fourteen miles long.

Most of the main chains send off branches, which form a succession of valleys and gorges opening towards the sea. The upper portions of the mountains and elevated ridges are generally composed of bare rock, presenting here and there the appearance of lofty cones, peaks, turrets, and serrated ramparts.

Between the bases of the mountains and the sea there are, more or less, all round the island, low-lying and nearly level plains. Rivière du Rempart and Pamplemousses, north of the Port-Louis mountains, and portions of Flacq, are, comparatively, one extensive plain, the greatest elevation attained by the railway which passes through them being only 329 feet, at a distance of six miles from the sea.

The island is drained by a great many rivers and streams, the largest of which take their rise on the tableland, receiving in their courses numerous tributaries from the mountains, and, as they flow onward through deep wooded ravines, forming in some places picturesque waterfalls. They all vary in volume according to the season, and occasionally some of them become quite dry.

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Both in the interior and near the coast there are lakes, marshes, and swamps. The principal of these are the *Grand Bassin*, in Savanne, at an elevation of 2000 feet, and covering a superficies of thirty to forty acres; the *Mare aux Vakois*, on the confines of Plaines Wilhelms and Black River, about 1900 feet above the sea-level, and having an area of about 1200 acres; the *Mare aux Lubines* and others on the lowlands of Flacq; a number of marshes in the lower parts of Grand Port; and several ponds, swamps, and marshes near the sea in Black River and in the neighbourhood of Port Louis. It need scarcely be remarked that the volume of water in these lakes and marshes varies with the rainfall.

The island is of basaltic formation, and the soil in many places is highly ferruginous. The surface of the ground is usually covered with loose stones; but here and there, particularly on the tableland, there are tracts of free soil, many feet deep, in which no stones occur, and in other places patches of solid *sheet-rock* as flat as a paved floor. Deep ravines and subterranean caverns abound in various parts.

At one time nearly the whole island was covered with dense forests, which, within the last twenty years, have been greatly diminished. Of the 432,000 acres forming the entire superficies of the island, it is estimated that there are still 80,000 acres of forest in a more or less dilapidated state, 150,000 acres in cultivation (chiefly under the sugar-cane), 110,000 acres in pasture, and the remainder in rock, river, and mountain.

Description and Positions of the Gauges.—Of the twenty-four gauges which have been used, sixteen are Glaisher's 8-inch gauge; the other eight are chiefly 3-inch gauges of French construction. The districts and stations where the observations were taken, the elevations of the gauges above the sea-level and the surface of the ground, their distances from the east and west coasts, &c., are given in the following Table (p. 175).

Being unable to refer to original documents, I can for the present only give the approximate heights of some of the stations; and for the same reason the character of the gauge and its exact height above the ground cannot, in a few cases, be specified.

It will be seen from the accompanying Map, on which the stations are laid down, and also from the Table, that all the districts are represented, and that there are two or three chains of stations stretching from coast to coast across the tableland.

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Districts.	Stations.	Approx. Height above the Sea-level.	Distance from East Coast.	Distance from West Coast.	Height of Gauge above Ground.	Character of Gauge.	Observers.	Periods of Observation.	
		feet.	miles.	miles.				years.	mths.
Flat Island	Surgeon's Quarters	30	...	...	8 inches	Glaisher's	Mr. M'Indoe	2	0
Rivière du Rempart	Labourdonnais	200	5	6	?	?	F. Béline, Esq.	5	0
Pamplemousses	Mont Choisy	50	7	½	?	?	H. Poulin, Esq.	5	0
	Les Rochers	180	8	4	?	?	H. Souchon, Esq.	5	0
	Botanical Gardens	250	10	4	8 inches	3-inch	J. Horne, Esq.	2	6
	Lucia	500	5	8	,,	Glaisher's	H. Barlow, Esq.	5	0
Port Louis	Caudan	8	16	0	,,	Royal Engs	Capts. Fyers and Stokes, R.E.	6	0
	The Observatory	47	16	0	40 feet	10×20 ins.	C. Meldrum, Esq.	8	0
Moka	Croft-an-Righ	850	19	7	8 inches	Glaisher's	C. A. Young, Esq.	3	0
	Bon Air	850	19	7	,,	,,	Hon. W. Telfair	1	8
	Gentilly	850	19	7	,,	,,	H. Finniss, Esq.	0	10
	Elizabeth Cottage	950	15	9	?	?	C. J. de Lissa, Esq.	0	9
	Espérance	1350	13	11	8 inches	Glaisher's	R. Telfair, Esq.	2	5
Flacq	La Gaieté	180	4	21	16 feet	3-inch	Dr. Icery	2	3
Plaines Wilhelms	St. Cloud	700	21	5	8 inches	Glaisher's	Hon. J. E. Arbuthnot	0	6
	Beau Séjour	930	19	6	,,	,,	Hon. R. Stein	5	0
	Trianon	900	18	7	,,	,,	Hon. C. Barclay	4	0
	Westra	1300	18	8	,,	,,	W. Traill and H. Wilson, Esqs.	1	2
	The Braes	1250	19	7	,,	,,	C. Grant, Esq.	5	0
	Mesnil	1450	16	10	?	3-inch	F. Channell, Esq.	1	10
Black River	Gros Cailloux	130	23	2	8 inches	Glaisher's	A. B. Commins, Esq.	5	0
Grand Port	Cluny	960	6	16	,,	,,	A. C. Macpherson, Esq.	5	0
	Beau Vallon	260	2	19	,,	,,	A. Rochecouste, Esq.	2	0
	Gros Bois	560	6	16	,,	,,	V. Vallet, Esq.	3	0
Savanne	St. Aubin	120	...	...	,,	,,	Hon. H. Pitot	2	0

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The observations, which were taken daily at 9 A.M., and entered for the previous day, were forwarded to the Observatory monthly, discussed, and published at the time in one of the local newspapers; for the rainfall is a subject in which the people of Mauritius take a deep interest.

With regard to the trustworthiness of the observations, I will only remark that the gauges were in a measure a check upon one another, and that the staff of observers was composed of Members of the Legislative Council, several leading Planters and Merchants, Newspaper-editors, and Government Officials.

I will now briefly point out some of the leading results.

Annual March of the Rainfall.—Since rainfall depends upon evaporation, and evaporation upon temperature, we should expect to find, in an island like Mauritius, a close connexion between the rainfall and the temperature; and the Tables show that such connexion exists. Thus, from Table I., which gives the results of six years' observation (1853–58) on the ground, at Port Louis, we find that the rainfall increases from 0·511 inch in September to 9·329 inches in February, and that, with the exception of a small increase in June, it decreases from February to September.

During the next eight years (1859–66) the observations at Port Louis were taken at the Observatory, about 400 yards east of the former station, and at 40 feet above the ground, and the results, which are given in Table II., show a similar progression. In place, however, of a tendency to a second maximum in June, we find a small but well-marked second maximum in August. From September to February the mean rainfall increases from 0·373 inch to 13·481 inches, from which it decreases to 0·753 inch in June; it then increases to 2·073 inches in August, from which it falls to 0·373 inch in September.

Turning now to Table VIII., which shows the results of five years' observation (1862–66) at nine stations in different parts of the island, we find an exactly similar march both for each station and for all the stations taken collectively. Over the parts of the island represented by the gauges, the rainfall increases from 2·005 inches in September to 12·886 inches in February; it afterwards decreases to 2·778 inches in June; it again increases to 4·898 inches in August, and then falls to 2·005 inches in September.

Tables III. to VII. afford materials for determining the annual

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march for two to four years at eight stations more, and the results are in every respect similar.

Generally, therefore, the annual march of the rainfall of Mauritius presents a double progression, having two maxima in February and August, and two minima in June and September. From September to January (the warmest month) the rainfall increases with the temperature, and attains its principal maximum in February; and from February to June it decreases with the temperature. Instead, however, of decreasing with the temperature in July (the coldest month) it increases, and continues increasing till August, when it has a second maximum before attaining its principal minimum in September.

It would thus appear that, notwithstanding the diminished evaporation in winter (temperature being regarded as the principal agent), the low temperature of July and August causes a more copious precipitation than takes place, with a higher temperature and greater evaporation, in May and June; or, it may be, that the increase of rain in July and August is partly due to an accelerated rate of evaporation in consequence of the strong and dry trade wind which then agitates the surface-waters of the surrounding ocean.

An examination of the monthly observations for each year will show that the annual march is subject to considerable fluctuation. Thus, during the fourteen years' observation at Port Louis, January was the rainiest month *four* times, February *six* times, and March, April, May, and June *once* each. A similar but smaller fluctuation occurred in the epochs of the other turning-points.

At other stations, during the five years 1862–66, similar fluctuations occurred.

These deviations are partly due to revolving storms, which are attended with torrents of rain, to the action of opposite winds (either general, like the S.E. trade wind and N.W. monsoon, or produced locally by the heated land and rocks) in forcing vapour up the sides of the mountains, and to thunderstorms, which, however, are often referable to the same causes. On six days in February 1861, for example, during a hurricane, 44·730 inches of rain fell at Port Louis; the consequence was that not only was February the rainiest month, which it ought to have been without the hurricane, but that the fall for the year far exceeded the mean annual fall. Again, during a thunderstorm in the night of the 24th to the 25th of May, 1862, 3·245 inches of rain fell at Port Louis, and

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greater amounts at other stations; so that, in several parts of the island, May was the rainiest month in that year.

Connexion between the Rainfall and Elevation, &c.—Taking the elevation alone into account, the results of five years' observation (1862–66), at nine stations, show that the rainfall increases with the height up to about 1000 feet, and then decreases. Thus:—

Mean Height. feet.	Mean Rainfall. inches.
120	44·712
500	67·985
945	106·907
1250	67·730

But there must be other conditions affecting the rainfall, for we find such anomalies as the fall at 960 feet being double the fall at 930 feet, and the fall at 50 feet nearly double the fall at 130 feet. Now these discordances disappear when we take into account the side of the island on which the gauge was placed, and the distance from the east coast, as well as the altitude. An analysis of all the observations, with respect to these several conditions, leads to the following conclusions:—

(1) On either side of the island the rainfall increases from the coast up to the highest station on that side, and attains a maximum at or near the summit of the eastern declivity, the line of maximum fall extending from near Labourdonnais, in the north, away to the southward, passing, probably, to the east of Espérance and to the west of Cluny, and thence to the neighbourhood of Grand Bassin and the Savanne mountains, in the south; and along this line the maximum rainfall itself varies, and is greatest in the highest and most wooded parts of the island near the commencement of the slope towards the east.

(2) The rainfall on the east coast is from two to three times greater than on the west coast.

(3) From the east coast westward to the highest stations on the eastern side, the increase of height is to the increase of rainfall nearly in the ratio of 5 to 2, and from the west coast eastward to the highest stations on the western side nearly in the ratio of 5 to 1.

(4) The rainfall at Espérance, one of the highest stations on the western side, is four times the rainfall at Gros Cailloux on the west coast; and the rainfall at Cluny, the highest station on the eastern side, is a little more than twice the fall at Beau Vallon and

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La Gaieté on the east coast, and five times the fall at Gros Cailloux.

(5) If the other conditions be the same, the nearer the station is to the east coast the greater is the rainfall.

There are apparently two exceptions to this last remark. The first is in the case of St. Aubin, near the southern extremity of the island, where the mean rainfall is considerably greater than at stations on the east coast, being for two years (1865–66) 93·057 inches. But the prevailing wind arrives at St. Aubin without passing over much land, and immediately to the northward of it there are steep ascents and high mountains.

The other exception is in the case of Flat Island, a small island about five miles north of the most northern point of Mauritius. The mean rainfall there for two years (1862–63), at 30 feet above the sea-level, was 32·280 inches, against 30·908 inches and 29·350 inches at Port Louis and Gros Cailloux, respectively, for the same period. But, though that island is further east than other stations at which the rainfall is much greater, it is at a greater distance from high land; and as it is but a small speck in the ocean, and the prevailing wind does not come to it from the mainland, it would seem that the rainfall there represents, approximately at least, the rainfall at sea; and if it does so, it follows that fully one-half of the rainfall of Mauritius is due to local causes, such as elevation.

Distribution of the Rainfall according to Season, &c.—The following is the order of the months according to the amount of rainfall:—February, January, March, December, August, April, May, July, June, November, October, September.

During the four months of December to March, the rainfall is above the mean monthly fall for the year, and during the other eight months below it. Hence the former months may be regarded as the *rainy season*, and the latter as the *dry season*. The term *dry*, however, applies with much more force to the three months of September to November.

An analysis of the observations shows:—

(1) That over the island, generally, 58 per cent. of the annual rainfall falls in December to March, whilst only 11 per cent. falls in September to November.

(2) That the seasons, with respect to rainfall, are much more distinct at the stations where the annual rainfall is least; that is, generally, at or near the coasts, and particularly on the west coast,

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as at Port Louis and Gros Cailloux, where 67 per cent. of the rain for the year falls in December to March, and only 7 per cent. in September to November; whereas at Cluny only 51 per cent. falls in December to March, and as much as 12 per cent. in September to November.

We thus see that the conditions which produce a much greater annual rainfall at certain stations, likewise tend to obliterate the distinction of seasons into dry and wet.

During fourteen years' observation at Port Louis, the greatest rainfall in any one month was 46·570 inches in February 1861, and the least, no rainfall at all, in November 1859 and November 1866 (this latter month being the least rainy on record). The greatest fall at Gros Cailloux for any one month during five years (1862–66) was 13·420 inches in February 1865, and the least 0·150 inch in November 1863 and September 1865. At Cluny, for the same five years, the greatest fall in any one month was 43·600 inches in December 1865, and the least 1·090 inch in November 1863. The greatest and least falls for any month at the other stations were intermediate.

The greatest rainfall on any one day at Port Louis in each year during fourteen years (1853–66) ranged from 10 inches on the 15th of February, 1861, to 1·720 inch on the 24th of March, 1866. At the other stations the greatest rainfall on any one day took place on the 12th of February, 1865, and on the 27th and 28th of December, 1865, on which occasions the fall in twenty-four hours ranged from 25 to 6 inches.

Rainy Days and Rain-bearing Winds.—The results for Port Louis under this head are as follows:—

The mean annual number of days on which rain falls is 134, viz. 16 in January, 17 in February, 15 in March, 10 in April, 9 in May, 8 in June, 11 in July, 12 in August, 7 in September, 8 in October, 9 in November, and 12 in December.

Hence the fluctuation in the frequency follows the same law as the fluctuation in the amount of the rainfall.

The number of times that rain may be expected to fall in the course of the year with the wind from each of the principal points of the compass is as follows:—north 6, north-east 13, east 51, south-east 40, south 3, south-west 1, west 3, north-west 10, calm 3.

Here we see, as might be expected, from its vast preponderance and its coming over a great expanse of evaporating surface, that the principal rain-bearing wind is the trade wind from S.E to E.N.E. In proportion to their frequency, however, the northerly

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and north-westerly winds bring fully as much rain as the trade wind, and some of the heaviest downfalls have been with the wind from the north and north-west, as on the 12th of February, 1865.

When rain from the north-west is general, the relation between the east and west coasts, with regard to rainfall, is reversed; which shows that the east coast owes its greater rainfall to its being on the windward side of the island.

The rainiest hours of the day are from 1 to 5 P.M.

Fluctuation of the Annual Rainfall.—The last columns in Tables I. & II. would exhibit the secular variation at Port Louis, so far as that could be done by fourteen years' observation, if the same gauge had been used under the same conditions.

Yet it is evident that from 1853 to 1856 the rainfall at Port Louis increased, and then decreased to 1858, the last year of the six years' series; that from 1858 to 1861 it increased, even at 40 feet above the ground; and that from 1861 to 1866 a very marked decrease took place.

The total fall during the last five years (1862–66) of the whole period of fourteen years (1853–66) was 151·265 inches, against 211·579 inches during the first five years (1853–57), and 237·041 inches during the five years 1857–61, leaving for the last five years (1862–66) deficiencies of 70·314 and 85·776 inches, respectively.

These deficiencies are partly due to difference of elevation, but, after making ample allowance, we find that the rainfall during the five years 1862–66 was considerably less than during any previous five years of the whole period.

Comparing, now, the monthly and yearly results for those five years, or (taking in 1861) for the six years 1861–66, *inter se*, and with those of the previous eight years, we find that the monthly and annual fluctuations were much greater in and after 1861 than before it. From 1861 to 1866, the yearly fall at Port Louis fluctuated between 68·733 and 20·571 inches, whereas during the previous eight years it only fluctuated between 46·665 and 35·341 inches; the fall in 1862 was less than half the fall in 1861, and the fall in 1866 less than half the fall in 1865. Again, in no former year of the period of fourteen years did such floods occur as in 1861 and 1865, or such severe droughts as in 1865 and 1866.

The fluctuation of the annual rainfall in other parts of the island during the five years 1862–66 will be seen in Table IX., an examination of which will show that the rainiest stations are subject to much less variation than the least rainy. Thus, at Cluny, the

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greatest and least annual falls were 192·45 and 122·48 inches, whereas at Gros Cailloux they were 36·57 and 20·72 inches, and at Port Louis 44·737 and 20·571 inches. Hence the conditions which make certain stations much more rainy than others, render the amount of annual fluctuation less.

We do not know from direct observation whether the rainfall over the island generally was less from 1862 to 1866 than during any previous five years; but the relation which is found to subsist between the rainfall at any one station and at all the stations, enables us to state that the diminution observed at Port Louis was not local but general. The Tables show clearly that *if the rainfall increases or diminishes at any one station, as Port Louis, it increases or diminishes at all the stations without exception.* Hence, as the rainfall at Port Louis was less during the five years 1862–66 than during any former five years since 1853, we infer that there was a similar decrease over the whole island.

We know, also, that in the course of that period there were excessive floods and droughts at all the stations, and that the sugar-cane, and, consequently, the general interests of the Colony, suffered greatly. And, as if it was not enough that vegetation alone should be blighted, the driest year of all (1866) has been followed by an epidemic which has already swept away fully one-tenth part of the population.

Destruction of the Forests.—The period of observation is too short to enable us to arrive at a satisfactory conclusion as to whether the decrease of rain in Mauritius, since 1861, is temporary or permanent. But, as during the last fifteen years, and, so far as can be ascertained, ever since the island was discovered, there has been no period of equal duration in which so little rain fell, and in which floods, droughts, and sickness have been so prevalent, it may be interesting to inquire whether any local changes of a physical character have taken place which might in any degree account for so unusual, or, it may be, unprecedented occurrences.

Now the only known change, which would be at all likely to produce, or tend to produce, any such effects, is the change which has been brought about in the condition of a large portion of the surface of the island by a rapid extension of population and agriculture, and a corresponding destruction of the primeval forests.

There is a considerable variety of indigenous trees, several of which attain heights of from 30 to 40 feet or more, and which at

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one time afforded excellent timber. With these trees and a variety of shrubs and creeping plants the island was at one time densely covered, except on the bare summits and steep rocky flanks of the mountains, and here and there where patches of savanna and some barren plains existed.

How many acres of these forests have been cut down, and how many still remain, are questions which cannot be fully answered, because no measurements have been made. We can only arrive at approximate estimates by considering the progress of population and agriculture.

In 1764 the population of the island was 18,732, from which it rose to 59,000 in 1797, 158,462 in 1846, 183,406 in 1851, and 313,462 in 1861. When the epidemic broke out, early in 1867, the population was about 340,000, or 485 to the square mile, which is a high rate.

The progress made by agriculture during the last twenty years has been very great. Thus the quantity of sugar (the only export) made in 1845–46 was only 45,610 tons, whereas in 1853–54 it was 90,746 tons, and 141,215 tons in 1862–63. From 1851 to 1856 the crop steadily increased; it then fluctuated, but, on the whole, increased up to 141,215 tons in 1862–63, which was the largest crop ever made. Since that time it has been decreasing.

This rapid increase of population and produce, since 1851, is due to immigration from India and to the importation of guano. By introducing Coolies to any required extent, and by using guano in the damp soils in the interior of the island, it was thought that fortunes might be realized, and the wealth of the Colony greatly increased; and so a vigorous attack was made upon the forests in all directions. Extensive tracts were brought under cultivation for the first time in Moka and Plaines Wilhelms on the tableland, and in the higher parts of Flacq, Grand Port, and Savanne, bordering on the tableland, which were the localities where the forests were most abundant. The yearly produce increased in all the districts, but more especially in those just mentioned. Thus the sugar-produce of Savanne rose from 5,615 tons in 1852 to 13,000 tons in 1862, that of Flacq from 15,000 to 37,875 tons, and that of Moka from 800 to 17,563 tons in the same period.

According to the Blue-Books for 1852 and 1864, there were 60,352 acres more in cultivation in the latter than in the former year in Flacq, Moka, Plaines Wilhelms, Grand Port, and Savanne,

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and the greater portion of that area had, previously to 1852, been in forest.

But that was only a part of the clearings that took place. As the population and cane-cultivation extended, buildings of every description (including many new sugar-factories) and the consumption of fuel increased. The wood felled for agricultural purposes did not supply the demand. Proprietors of forests in high and remote parts of the island, where the climate was as yet too damp and rainy for the sugar-cane, also engaged in the work of destruction, partly because the wood fetched a high price, and partly because, seeing that the tablelands at lower levels were becoming productive, they believed that in course of time their land also would become fit for cultivation; for it was very well known and admitted that the climate became drier in proportion as the forests were cut down. In this way large tracts of forest have been either much thinned or entirely cleared in localities which have not been cultivated.

Upon the whole, I think that at least 70,000 acres, or about one-sixth of the entire area of the island, have been denuded of forest since 1852, and that, too, on the central and elevated parts, at or near the sources of the rivers, and in the neighbourhood of swamps and marshes, as at the *Mare aux Vakois*, close to which sugar-plantations have been lately commenced.

It is difficult to say what is the extent of forest still remaining; only very small portions are intact. Altogether, there may be 80,000 acres, of which a large part is in a state of decadence.

Effects of Denudation.—Now, without entering into a discussion of the subject, it seems to me that the destruction of the forests in a tropical island like Mauritius would be followed by a decrease of the humidity, an elevation of the temperature, and a diminution of the rainfall.

With regard to the first of these probable effects, it requires no instrumental observations to show that the climate in the interior of the island is much drier now than it was some years ago. The inhabitants of Moka and the upper parts of Plaines Wilhelms have had practical proof of the difference in the fact that before those districts were planted with canes, it was necessary to expose, at short intervals, clothes, books, furniture, &c., to sun and air, in order to protect them from mould.

The change, in this respect, in the littoral and drier parts, has of course been less; but it seems to be appreciable even at Port

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Louis. Thus the mean relative humidity there for periods of five years, since 1853, has been as follows:—

Years.	Relative humidity.
1853–57	72·1
1858–62	73·1
1863–67	68·2

The very marked decrease since 1862 cannot well be accounted for, except on the supposition that, as the trade wind passes over the tableland before reaching the Observatory, the effects of the clearings upon the humidity of the air, away to windward, has extended to Port Louis.

Observations have not been made sufficiently long and regularly at any station in the interior to show whether or not the temperature has increased where forest once existed. At Port Louis the mean temperature in the shade for groups of five years, since 1853, has been as follows:—

Years.	Temperature.
1853–57	76·6
1858–62	77·0
1863–67	77·2

These figures appear to indicate a slight upward tendency.

I have already shown that the rainfall, since 1861, has decreased.

The vapour-pressure also has decreased. Thus:—

Years.	Vapour-pressure.
1853–57	·657
1858–62	·665
1863–67	·638

I would submit, then, that the decrease of rainfall, humidity, and vapour-pressure, and the occurrence of floods and droughts, since 1861, may in some measure be due to the cutting-down of the forests, which commenced on an extensive scale about 1852, was vigorously carried on till 1862, and is being still prosecuted, though to a smaller extent.

The rainfall returns for 1867 have not yet been received; but I am informed that at Port Louis, for that year, the fall was 35·97 inches, which is much greater than the fall in 1866, but still considerably below the mean for the last fifteen years. It would

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appear also that in the course of the present year there have been copious rains, and on one or two occasions heavy floods, which may yet be followed by corresponding droughts, as in 1865.

With a view to elucidate still further this interesting and important subject, I hope to have observations taken at localities which, as far as possible, shall only differ from each other with respect to forest. As yet we only know generally that the stations nearest the remaining forests are the rainiest, without being able to determine how much of the rainfall is due to forest, and how much to elevation and aspect.

Outbreak of Fever in 1867.—There are some considerations which seem to indicate that the terrible fever which has lately been devastating the island may be a consequence of the climatic changes brought about either by the felling of the forests, or by some less probable cause.

The fever, which is entirely local and non-contagious, was never before known in the island as an epidemic. Now, as has been stated above, at no former period, so far as can be ascertained, were floods and droughts so prevalent, and the annual rainfall so small, as during the five years which preceded the outbreak of fever.

It is admitted by all that the fever is *malarious*. The conditions, therefore, which favour the production of malaria, must, one would suppose, have had greater play than formerly; and this seems to have been the case. The ponds, swamps, and marshes, on the lowlands near the coast, which are supplied with water not only by the rains which fall there, but by drainage and percolation from the more elevated grounds, where the rains are heaviest, necessarily become more or less dry in periods of general drought, whilst in periods of heavy rains they overflow. On the 12th of February, 1865, all the low-lying grounds were swamped, and the swollen streams brought down much vegetable débris, which partially filled the ponds and lagoons. As the flood was followed in the course of the year by droughts, these organic deposits were partly laid bare. Somewhat similar floods took place in December of the same year. The following year (1866) was perhaps the driest ever known in the island; and it was soon after the close of that year, when the ponds and streams had been exposed to a severe drought, and certain swamps and marshes been partially dried up, that the fever became so virulent as to attract general attention.

But although it did not assume the same magnitude, it would

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appear that the fever broke out as an epidemic for the first time, after a less intense drought, early in 1866, if not in 1865, and that it did so in the very driest spot in the island, viz. Gros Cailloux, in close proximity to lagoons, and at a time when an attempt was being made to dry one of them up.

Not only did the epidemic make its appearance in the driest spot, but it has throughout been confined to the driest parts, and, till recently, to the littoral on the western side of the island, where the rainfall is much less than on the eastern side. There are marshes in other parts of the island, but they do not fall so low during droughts as those near Gros Cailloux and Port Louis on the west coast, the rainfall on the western slopes being always less than on the eastern.

There is little doubt that the overcrowded and greatly neglected state of Port Louis and many other localities contributed very much to swell the mortality; but the determining cause of the outbreak of the disease seems to have been the altered hygrometric state of the island.

If that is really the cause, and if the change in climate is due to denudation, it would seem that the principal calamities which have recently befallen the people of Mauritius are self-inflicted, and that the proper remedy is to restore, as far as practicable, certain portions of the forests of which this once salubrious and beautiful island has been deprived. With a view to the accomplishment of that desirable object, to which attention had in vain been long ago directed by Mr. Bouton and other colonists, His Excellency the Governor, Sir Henry Barkly, has appointed a Commission to report upon the whole matter.

The copious rainfalls during the summer months of the present year may raise a doubt as to the expediency of an inquiry. But it should be borne in mind that the summer rains are always excessive when, as from December to May last, revolving storms are of frequent occurrence. Summers in which few hurricanes occur in the Indian Ocean, and the dry months of September to November, are the periods when the effects of denudation are likely to show themselves most prominently. Besides, the main question is not merely whether the annual rainfall is less than formerly, but also whether a change has taken place in its distribution, and whether the humidity has decreased.

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TABLE I. Rainfall at Port Louis from January 1853 to December 1858 inclusive, on the ground, and about 8 feet above the sea-level.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Fall.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
1853.	4·425	5·804	4·536	5·959	6·755	8·140	0·795	0·985	0·685	0·480	0·685	0·580	39·829
1854.	4·120	10·955	3·705	12·130	1·320	0·950	0·715	0·320	0·150	0·555	0·480	4·020	39·420
1855.	6·685	17·400	8·195	2·095	0·550	2·410	0·790	1·090	0·600	0·475	1·265	1·110	42·665
1856.	0·720	10·475	10·490	3·455	2·280	0·330	0·955	0·695	0·110	1·960	5·210	9·540	46·220
1857.	13·530	7·605	6·355	2·420	0·190	0·860	0·705	0·400	0·910	0·635	4·360	5·475	43·445
1858.	13·360	3·735	3·495	3·070	1·266	1·130	1·140	0·705	0·610	0·790	1·840	4·200	35·341
Means...	7·140	9·329	6·129	4·855	2·061	2·303	0·850	0·699	0·511	0·816	2·307	4·154	41·153

The mean monthly fall is 3·429 inches.

TABLE II. Rainfall at Port Louis from January 1859 to December 1866 inclusive, at 40 feet above the ground, and about 47 feet above the sea-level.

1859.	2·258	8·244	7·885	5·894	6·496	0·965	0·583	3·247	0·225	1·304	0·000	7·235	44·336
1860.	14·652	13·552	7·575	1·252	1·325	0·450	0·850	2·172	0·382	0·527	0·162	2·267	45·166
1861.	5·368	46·570	2·475	3·224	3·727	0·868	0·450	1·840	0·000	0·025	2·151	2·035	68·733
1862.	4·019	4·695	5·970	1·845	6·760	0·580	0·600	1·090	0·314	0·589	0·806	1·129	28·397
1863.	9·484	10·955	3·431	1·491	0·712	1·707	0·726	0·292	0·725	1·175	0·355	2·367	33·420
1864.	2·318	5·753	2·995	1·921	0·510	0·310	1·472	3·935	0·368	0·835	1·900	1·830	24·147
1865.	3·270	15·543	3·170	0·770	0·220	0·770	2·354	3·280	0·600	0·818	1·842	12·093	44·730
1866.	5·413	2·535	3·815	4·785	1·164	0·374	0·355	0·730	0·366	0·244	0·000	0·790	20·571
Means...	5·848	13·481	4·664	2·648	2·614	0·753	0·924	2·073	0·373	0·690	0·902	3·718	38·688

The mean monthly fall is 3·224 inches.

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TABLE III. Rainfall at Ten Stations in Mauritius during the Year 1862.

Months.	Flat Island. Mr. Macindoe. 30 feet.	Pamplemousses. Mont Choisy. Mr. Poulin. 50 feet.	Pamplemousses. Les Rochers. Mr. Souchon. 180 feet.	Pamplemousses. Lucia. Mr. Barlow. 500 feet.	Rivière du Rempart. Labourdonnais. Mr. Béline. 200 feet.	Port Louis. Observatory. Mr. Meldrum. 47 feet.	Black River. Gros Cailloux. Mr. Commins. 130 feet.	Plaines Wilhelms. Beau Séjour. Mr. Stein. 930 feet.	Plaines Wilhelms. The Brass. Mr. Grant. 1250 feet.	Grand Port. Cluny. Mr. Macpherson. 960 feet.	Monthly Means.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
January	8·20	7·952	10·580	11·15	11·64	4·019	6·39	12·95	8·80	16·09	9·777
February ...	4·16	13·031	5·919	9·16	7·56	4·695	6·22	10·67	14·27	19·08	9·476
March.....	3·53	3·740	5·170	6·99	5·05	5·970	2·53	7·74	9·61	19·54	6·987
April	0·74	0·669	0·588	1·79	1·12	1·845	1·79	7·43	9·85	11·43	3·728
May	3·67	10·156	9·673	11·86	13·93	6·760	4·09	6·69	4·06	14·03	8·492
June	0·68	0·393	0·270	1·16	0·34	0·580	0·36	1·04	0·51	1·92	0·725
July	2·31	1·494	3·220	5·48	3·43	0·600	0·77	4·28	2·08	8·41	3·207
August	1·31	0·866	1·410	2·37	1·92	1·090	0·96	3·33	2·30	7·24	2·279
September ...	0·19	0·236	0·770	0·67	1·07	0·314	0·05	2·23	0·78	2·83	0·914
October	0·69	1·571	1·960	2·03	1·66	0·589	0·32	1·58	1·02	3·55	1·497
November ...	0·40	0·391	0·930	5·18	1·59	0·806	0·71	4·12	0·68	9·32	2·413
December ...	2·14	1·061	1·350	2·87	2·92	1·129	1·16	7·01	5·55	9·10	3·429
Fall for Year ...	28·02	41·560	41·840	60·71	52·23	28·397	25·35	69·07	59·51	122·54	52·922

The mean monthly fall at the ten stations is 4·410 inches.

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TABLE IV. Rainfall at Eleven Stations in

Months.	Flat Island. Mr. Macindoe. 30 feet.	Pamplemousses. Mont Choisy. Mr. Poulin. 50 feet.	Pamplemousses. Les Rochers. Mr. Souchon. 180 feet.	Pamplemousses. Lucia. Mr. Barlow. 500 feet.	Pamplemousses. Botanical Gardens. Mr. Horne. 250 feet.	Rivière du Rempart. Labourdonnais, Mr. Béline. 200 feet.
	ins.	ins.	ins.	ins.	ins.	ins.
January	9·07	13·792	15·879	14·060	.....	20·31
February ...	9·22	17·825	14·008	12·870	15·541	12·93
March	4·07	6·443	10·549	10·305	14·350	6·93
April	4·39	2·714	5·766	5·515	6·806	5·78
May	1·59	2·480	2·758	3·085	4·048	4·05
June	3·70	4·653	5·072	6·285	7·430	6·86
July	1·09	2·103	1·723	3·500	3·299	2·73
August	0·62	1·685	1·776	4·055	3·734	1·56
September ...	0·54	1·316	1·632	2·675	2·357	1·94
October	0·70	0·706	1·287	1·650	0·824	1·11
November ...	0·07	0·059	0·304	0·650	0·393	1·45
December ...	1·48	0·884	3·521	3·220	2·594	5·07
Fall for Year ...	36·54	54·660	64·275	67·870	.....	70·72

TABLE V. Rainfall at Thirteen Stations in

Months.	Flat Island. Mr. Macindoe. 30 feet.	Flacq. La Gaieté. Dr. Icery. 180 feet.	Pamplemousses. Mont Choisy. Mr. Poulin. 50 feet.	Pamplemousses. Les Rochers. Mr. Souchon. 180 feet.	Pamplemousses. Lucia. Mr. Barlow. 500 feet.	Pamplemousses. Botanical Gardens. Mr. Horne. 250 feet.	Rivière du Rempart. Labourdonnais. Mr. Béline. 200 feet.	Port Louis. Observatory. Mr. Meldrum. 47 feet.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
January	3·46	.....	3·182	3·630	3·150	3·300	4·25	2·318
February ...	8·00	.....	8·577	9·990	9·045	9·441	11·93	5·753
March	1·17	.....	2·690	5·811	3·265	4·678	3·27	2·995
April	5·29	.....	4·802	3·812	5·675	3·657	4·88	1·921
May	0·73	.....	3·773	1·341	2·305	3·893	2·55	0·510
June	1·64	.....	1·653	1·462	3·725	4·327	3·09	0·310
July	1·76	.....	3·084	2·622	5·980	4·561	5·88	1·472
August	2·62	.....	10·392	5·537	7·040	3·740	7·88	3·935
September ...	.....	.....	3·365	2·187	2·195	2·165	2·19	0·368
October	.....	4·567	0·979	1·006	3·905	0·905	3·90	0·835
November ...	.....	5·945	2·401	2·111	4·360	4·825	3·46	1·900
December ...	.....	7·874	3·996	3·143	7·295	6·063	3·97	1·830
Fall for Year ...	.....	.....	48·894	42·652	57·940	51·555	57·25	24·147

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Mauritius during the Year 1863.

Port Louis.	Black River.	Moka.	Plaines Wilhelms.			Grand Port.	Monthly Means.
Observatory. Mr. Meldrum. 47 feet.	Gros Cailloux. Mr. Commins. 130 feet.	Bon Air. Hon. Mr. W. Telfair. 850 feet.	Bean Séjour. Hon. Mr. Stein. 930 feet.	Trianon. Mr. Barclay. 900 feet.	The Brass. Mr. Grant. 1250 feet.	Cluny. Mr. Macpherson. 960 feet.	
ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
9·484	8·03	.....	20·14	15·73	16·46	25·42	15·307
10·955	10·60	15·29	23·89	22·32	20·26	24·33	16·292
3·431	2·81	5·49	7·91	10·03	9·83	25·94	8·931
1·491	2·58	3·77	5·76	3·83	5·72	13·50	5·186
0·712	0·37	4·62	2·91	2·47	2·24	5·18	2·531
1·707	1·36	6·85	8·91	7·09	6·26	13·09	5·908
0·726	0·80	4·08	4·61	3·29	3·45	8·96	2·999
0·292	0·40	2·89	3·32	2·80	2·78	12·33	2·874
0·725	1·98	5·75	4·06	4·77	5·43	4·83	2·717
1·175	0·84	2·73	3·68	2·02	1·73	4·37	1·752
0·355	0·15	0·38	1·72	0·55	0·73	1·09	0·648
2·367	3·43	8·51	12·85	5·76	6·20	8·05	4·803
33·420	33·35	.....	99·76	80·66	81·09	147·09	69·948

Mauritius during the Year 1864.

Black River.	Moka.			Plaines Wilhelms.			Grand Port.		Savanne.	Monthly Means.
Gros Cailloux. Mr. Commins. 130 feet.	Espérance. Mr. R. Telfair. 1350 feet.	Bon Air. Hon. Mr. W. Telfair. 850 feet.	Croft-an-Righ. Mr. Young. 850 feet.	Bean Séjour. Hon. Mr. Stein. 930 feet.	Trianon. Mr. Barclay. 900 feet.	The Brass. Mr. Grant. 1250 feet.	Cluny. Mr. Macpherson. 960 feet.	Gros Bois. Mr. Vallet. 860 feet.	St. Aubin. Hon. Mr. Pitot. 120 feet.	
ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
1·61	.....	4·49	4·97	3·84	5·04	5·23	11·18	5·05	.....	4·365
5·13	.....	9·13	9·23	10·42	7·33	8·48	21·94	14·36	.....	10·125
6·04	.....	5·44	6·15	8·14	8·90	12·99	7·04	4·64	.....	5·893
1·83	.....	5·15	5·63	5·46	5·25	7·08	13·86	10·56	.....	5·724
0·61	.....	1·52	1·29	1·28	0·42	1·60	3·28	4·70	.....	2·119
0·34	.....	3·00	2·54	3·18	2·94	2·52	7·62	5·05	.....	2·981
1·66	.....	3·56	3·42	4·82	4·74	3·77	8·97	6·24	.....	4·401
4·21	12·76	7·33	7·31	6·65	4·62	7·44	15·07	12·04	.....	7·374
0·20	3·27	1·76	2·63	1·75	1·33	3·94	4·63	3·01	0·415	2·305
0·37	4·02	.....	1·14	1·30	1·34	2·59	5·47	3·40	3·690	2·088
1·42	7·05	.....	9·62	4·05	2·97	10·13	8·10	5·23	6·135	4·660
0·75	12·09	.....	2·68	3·71	3·70	4·82	15·32	9·08	6·910	5·104
24·17	.....	.....	56·61	54·60	48·58	70·59	122·48	83·36	.....	57·140

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TABLE VI. Rainfall at Seventeen Stations in

Months.	Flacq.	Pamplemousses.				Rivière du Rempart.	Port Louis.	Black River.	Moka.	
	La Gaieté. Dr. Icery. 180 feet.	Mont Choisy. Mr. Poulin. 50 feet.	Les Rochers. Mr. Souchon. 180 feet.	Lucia. Mr. Barlow. 500 feet.	Botanical Gardens. Mr. Horne. 250 feet.	Labourdonnais. Mr. Béline. 200 feet.	Observatory. Mr. Meldrum. 47 feet.	Gros Cailloux. Mr. Commins. 130 feet.	Espérance. Mr. R. Telfair. 1350 feet.	Crofton-Righ. Mr. Young. 850 feet.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
January	6·293	1·907	1·763	5·290	4·837	4·95	3·270	1·74	10·74	5·56
February ...	34·761	17·516	18·807	25·575	19·018	25·89	15·543	13·42	32·31	30·49
March.....	11·145	7·833	6·792	7·285	7·533	9·83	3·170	2·98	18·77	7·68
April	0·277	1·280	0·732	4·625	2·950	1·65	0·770	0·53	7·42	1·38
May	0·076	3·068	1·523	4·110	2·357	3·85	0·220	2·33	5·09	1·63
June	3·770	1·529	1·104	2·230	1·966	2·37	0·777	0·43	6·69	1·74
July	1·275	2·260	2·664	2·920	3·497	3·78	2·354	0·42	5·57	1·79
August	9·088	6·237	5·212	14·635	8·525	8·89	3·280	3·71	16·26	6·29
September ...	1·456	1·338	1·985	2·070	2·329	2·06	0·600	0·15	4·19	2·00
October	2·480	2·793	2·372	2·780	3·260	2·49	0·818	1·21	6·24	3·34
November ...	4·526	1·002	1·944	5·615	3·500	3·50	1·842	1·24	5·23	2·38
December ...	22·399	20·769	16·051	24·430	25·599	18·37	12·093	8·41	29·23	15·16
Fall for Year ...	97·546	67·532	60·949	101·565	85·371	87·63	44·737	36·57	147·74	79·44

TABLE VII. Rainfall at Seventeen Stations in

Months.	Flacq.	Pamplemousses.				Rivière du Rempart.	Port Louis.	Black River.	Moka.	
	La Gaieté. Dr. Icery. 180 feet.	Mont Choisy. Mr. Poulin. 50 feet.	Les Rochers. Mr. Souchon. 180 feet.	Lucia. Mr. Barlow. 500 feet.	Botanical Gardens. Mr. Horne. 250 feet.	Labourdonnais. Mr. Béline. 200 feet.	Observatory. Mr. Meldrum. 47 feet.	Gros Cailloux. Mr. Commins. 130 feet.	Espérance. Mr. R. Telfair. 1350 feet.	Crofton-Righ. Mr. Young. 850 feet.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
January	5·506	17·358	12·736	9·770	9·079	15·33	5·413	2·88	15·10	8·12
February ...	4·880	4·189	4·491	4·750	6·844	3·24	2·535	2·45	9·26	5·98
March	9·562	8·500	6·494	11·790	7·037	11·27	3·815	7·12	9·76	4·38
April	7·555	4·740	6·698	7·490	7·555	6·61	4·785	2·55	12·36	4·97
May	6·742	1·849	3·230	3·725	1·651	3·28	1·164	2·54	7·06	2·40
June	2·876	1·003	0·762	0·825	.....	0·73	0·374	0·38	4·32	1·81
July	4·838	1·847	1·325	2·335	.....	2·38	0·355	0·19	3·96	2·64
August	3·576	2·242	1·602	3·135	.....	2·18	0·730	0·22	7·16	2·26
September ...	3·106	0·785	1·026	1·790	.....	1·31	0·366	0·62	4·92	1·52
October	2·564	0·766	0·665	1·935	.....	1·26	0·244	0·27	3·70	1·24
November ...	0·588	0·570	0·305	0·605	.....	0·47	0·000	0·17	2·29	0·61
December ...	5·979	1·200	1·497	3·690	3·482	2·23	0·790	1·33	8·13	4·75
Fall for Year .	57·772	45·049	40·831	51·840	.....	50·29	20·571	20·72	88·02	40·68

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Mauritius during the Year 1865.

Plaines Wilhelms.						Grand Port.			Savanne.	
St. Cloud. Hon. Mr. Arbuthnot. 700 feet.	Beau Séjour. Hon. Mr. Stein. 930 feet.	Trianon. Hon. Mr. Barclay. 900 feet.	The Brass. Mr. Grant. 1240 feet.	Westra. Mr. Traill. 1300 feet.	Mesnil. Mr. Channell. 1450 feet.	Cluny. Mr. Macpherson. 960 feet.	Gros Bois. Mr. Vallet. 560 feet.	Beau Vallon. Mr. Rochecouste. 260 feet.	St. Aubin. Hon. Mr. Pitot. 130 feet.	Monthly Means.
ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
.....	6·71	5·64	3·23	.....	.....	7·15	7·55	4·480	6·670	5·164
.....	29·40	27·79	27·90	.....	.....	29·84	17·86	15·355	18·270	23·514
6·62	10·34	9·35	7·43	.....	17·94	28·57	14·96	6·725	9·640	10·002
.....	1·71	1·44	2·46	2·34	4·11	7·81	6·86	4·275	4·925	3·006
.....	3·26	2·78	1·71	3·59	4·15	9·55	7·64	5·205	7·070	3·616
1·12	2·10	1·92	2·74	3·03	4·51	9·20	4·94	3·875	3·490	2·992
0·95	1·68	2·09	3 14	2·89	4·58	7·95	4·29	2·055	3·100	2·990
4·06	5·97	5·29	5·31	.....	8·30	22·16	15·84	11·870	15·895	9·674
0·90	1·85	3·04	2·73	.....	4·77	7·28	5·06	3·690	3·135	2·645
.....	2·65	2·91	1·95	.....	4·33	10·19	4·48	3·275	4·460	3·394
.....	3·49	2·40	1·78	.....	2·63	9·15	7·85	8·385	4·805	4·038
12·88	17·95	16·54	18·39	.....	17·55	43·60	37·88	31·655	34·145	23·098
.....	87·11	81·19	78·77	.....	.....	192·45	135·21	100·845	115·605	94·133

Mauritius during the Year 1866.

Moka.		Plaines Wilhelms.					Grand Port.			Savanne.	
Elisabeth Cottage. Mr. De Lisle. 950 feet.	Gentilly. Mr. Finnies. 850 feet.	Beau Séjour. Hon. Mr. Stein. 930 feet.	Trianon. Hon. Mr. Barclay. 900 feet.	The Brass. Mr. Grant. 1250 feet.	Westra. Mr. Wilson. 1300 feet.	Mesnil. Mr. Channell. 1450 feet.	Cluny. Mr. Macpherson. 960 feet.	Gros Bois. Mr. Vallet. 560 feet.	Beau Vallon. Mr. Rochecouste. 260 feet.	St. Aubin. Hon Mr. Pitot. 130 feet.	Monthly Means.
ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
.....	.....	6·16	7·98	6·60	.....	9·93	16·41	5·85	3·38	10·810	9·373
.....	.....	6·39	4·35	6·75	.....	7·05	11·67	6·82	6·85	9·365	5·942
.....	4·22	9·67	6·24	7·09	2·60	7·22	11·76	7·70	5·63	5·990	7·882
8·175	4·88	4·49	4·12	5·46	4·32	7·83	17·59	11·24	9·77	10·160	7·554
2·680	2·59	2·28	2·68	3·06	3·83	4·96	9·15	3·76	3·63	7·105	4·036
3·508	3·09	2·70	3·08	2·57	4·81	5·55	8·51	4·09	3·36	3·455	2·729
2·500	2·96	2·46	2·29	3·45	3·75	4·52	16·18	5·51	4·19	5·725	3·776
2·657	3·11	2·62	3·24	3·56	4·20	5·67	10·86	4·95	2·24	3·300	3·503
1·802	2·09	1·53	1·87	2·17	2·59	3·32	6·17	4·21	2·04	3·790	2·385
1·395	1·46	1·55	1·67	1·75	1·10	3·03	6·52	3·80	1·95	2·580	2·088
0·745	0·78	0·56	0·84	1·54	1·08	2·03	4·11	2·81	0·34	1·555	1·023
6·475	5·53	4·14	4·88	4·69	4·83	6·56	10·49	9·50	7·67	6·675	5·541
.....	.....	44·55	43·24	48·69	.....	67·67	129·42	70·24	51·05	70·510	55·832

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TABLE VIII. Mean Monthly and Mean Annual
Five Years obser-

Stations.	January.	February.	March.	April.	May.	June.
	ins.	ins.	ins.	ins.	ins.	ins.
Mont Choisy.....	8·838	12·227	5·841	2·841	4·263	1·846
Les Rochers	8·918	10·643	6·963	3·519	3·705	1·734
Lucia	8·684	12·280	7·927	5·019	5·017	2·845
Labourdonnais ...	11·296	12·310	7·270	4·008	5·532	2·678
Port Louis.....	4·901	7·896	3·876	2·162	1·873	0·750
Gros Cailloux ...	4·130	7·564	4·296	1·856	1·988	0·574
Beau Séjour	9·960	16·154	8·760	4·970	3·284	3·586
The Braes	8·064	15·532	9·390	6·114	2·534	2·920
Cluny.....	15·250	21·372	18·570	12·838	8·238	8·068
Means	8·893	12·886	8·099	4·814	4·048	2·778

TABLE IX. Annual Rainfall at Nine Stations in

Years.	Pamplemousses.			Rivière du Rempart.
	Mont Choisy. Mr. Poulin. 50 feet.	Les Rochers. Mr. Souchon. 180 feet.	Lucia. Mr. Barlow. 500 feet.	Labourdonnais. Mr. Béline. 200 feet.
	ins.	ins.	ins.	ins.
1862.....	41·560	41·840	60·710	52·23
1863.....	54·660	64·275	67·870	70·72
1864.....	48·894	42·652	57·940	57·25
1865.....	67·532	60·949	101·565	87·63
1866.....	45·049	40·831	51·840	50·29
Means	51·540	50·109	67·985	63·624

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Rainfall at Nine Stations in Mauritius derived from vations (1862–66).

July.	August.	September.	October.	November.	December.	Annual Means.
ins.	ins.	ins.	ins.	ins.	ins.	ins.
2·157	4·284	1·414	1·363	0·885	5·582	51·541
2·311	3·107	1·520	1·458	1·119	5·112	50·109
4·043	6·247	1·880	2·460	3·282	8·301	67·985
3·640	4·486	1·714	2·084	2·094	6·512	63·624
1·102	1·866	0·474	0·732	0·980	3·642	30·254
0·768	1·900	0·600	0·602	0·738	3·016	28·032
3·570	4·378	2·284	2·152	2·788	9·132	71·018
3·178	4·278	3·010	1·808	2·972	7·930	67·730
10·094	13·532	5·148	6·020	6·354	17·312	142.796
3·429	4·898	2·005	2·075	2·357	7·393	63·675

Mauritius from 1862 to 1866 inclusive.

Port Louis.	Black River.	Plaines Wilhelms.		Grand Port.	Means.
Observatory. Mr. Meldrum. 47 feet.	Gros Cailloux. Mr. Commins. 130 feet.	Beau Séjour. Hon. Mr. Stein. 930 feet.	The Brae. Mr. Grant. 1250 feet.	Cluny. Mr. Macpherson. 960 feet.	
ins.	ins.	ins.	ins.	ins.	ins.
28·397	25·35	69·07	59·51	122·54	55·690
33·420	33·35	99·76	81·09	147·09	72·471
24·147	24·17	54·60	70·59	122·48	55·858
44·737	36·57	87·11	78·77	192·45	84·146
20·571	20·72	44·55	48·69	129·42	50·218
30·254	28·032	71·018	67·730	142·796	63·676

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XIX. *Notes on the Unusual Heat and Great Dryness of the Atmosphere on May* 19, 1868; *and on the remarkable Thunderstorm of May* 29, 1868, *as observed at Greenwich.* By W. C. NASH, Esq., F.M.S., of the Magnetical and Meteorological Department, Royal Observatory, Greenwich.

[PLATE VII.]

THE 19th of May was no less remarkable for its great and unusual heat than for the extraordinary dryness of the atmosphere throughout the day. The maximum temperature of the air was 87°, a higher value than has previously been recorded in the month of May, in the period 1841–67, the highest previous value having been 86°·2 in the year 1847; and the mean temperature for the day (71°·4) was in excess, as compared with the fifty years' average, to the amount of 18°·2. This value, however, has been exceeded on the following occasions in May, viz. on the 15th in 1833, when the mean temperature was 72°·4; on the 17th in the same year (1833), when it was 72°·2; and on the 28th, in the year 1847, when 72°·2 was again recorded.

With regard to the degree of humidity, it was remarked that at the commencement of the day the air was in a more humid state than it would have been had an average condition prevailed; but, that as the temperature of the air rapidly increased, so the degree of humidity became rapidly less, until, at the hottest part of the day, the degree of humidity was as small as 29.

The changes both of temperature and humidity on this day, however, can be more readily seen by reference to the annexed diagram (Plate VII.), which contains also the diurnal curves of approximate mean temperature and degree of humidity, so that the great departures of both temperature and humidity from normal conditions can at once be easily seen.

Variable weather followed this day of excessive heat, the barometer declining to 29·49 inches by the 24th, and showers of rain were experienced from the 20th to the 25th; then from the 26th to the 28th the weather was fine and warm, the latter day being almost cloudless throughout.

The morning of the 29th was very sultry, and dark clouds gathering in all directions gave indication of approaching rain, which soon followed in a slight shower about 11 A.M. accompanied by distant thunder. After this partial shower the clouds still hovered about threateningly, and at $0^h\ 25^m$ P.M. began to mass

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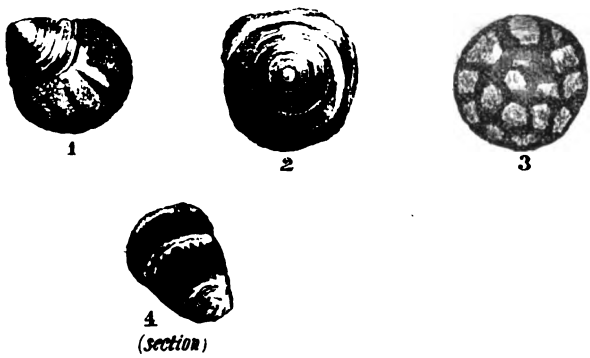
together and to indicate that they were surcharged with electricity. At first thunder was heard distantly in the S.W., then large drops of rain began to fall at $0^h\ 34^m$ P.M., and the storm approached with great rapidity from the S. and S.W., speedily became localized, and raged with much violence from $0^h\ 38^m$ P.M. Heavy rain fell unremittingly, and vivid lightning and thunder occurred at brief intervals in all parts of the sky. Little change took place till $1^h\ 21^m$ P.M., when hailstones, of larger size than I ever remember to have seen, fell with very great violence for four minutes and speedily covered the ground. These enormous hailstones were generally spheroidal in shape, and of variable size, the largest noticed measured 0·70 inch by 0·58 inch, and weighed 33 grains. Six other stones weighed in the aggregate 125 grains, or nearly 21 grains apiece. Their construction appeared (so far as I saw) to consist of four concentric layers of ice; and this peculiarity is well shown in two of the annexed drawings (figs. 1 and 2), and also in the sectional drawing (fig. 4). These drawings, illustrative of three well-marked and recurrent forms, were carefully drawn to the scale of the objects themselves by Mr. G. W. Farncomb, of the Magnetical and Meteorological Department, Royal Observatory.



After the hail had ceased falling, rain still continued; but it was very evident that the storm had passed completely away northwards, in which direction lightning was still seen and thunder heard at intervals. At $1^h\ 35^m$ P.M. rain ceased, and the amount of water collected in a gauge, with its receiving-surface 5 inches above the ground, was found to be 0·935 inch.

At 2 P.M. every distant object could be seen with remarkable

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distinctness, more especially in the north, where even the smaller ropes on vessels could be seen sharply defined against the dark background of storm-cloud; this appearance continued for about twenty minutes, when the whole view north of the Thames was interrupted by dense mist. Lightning still continued to be seen low down in the north, and very distant thunder was heard at intervals; but by 3 P.M. even these manifestations ceased.

In the afternoon showers of rain, with occasional hail, and accompanied by thunder, were experienced between $4^h\ 42^m$ P.M. and $4^h\ 56^m$ P.M., and between $5^h\ 45^m$ P.M. and $6^h\ 10^m$ P.M.; and the amount of rain collected in these showers made the total rainfall for the day 1·08 inch.

Thunderstorms were of wide-spread occurrence throughout England on this day, occurring at Dorset Square, London, and at Battersea about the same time as at Greenwich; earlier at Gloucester, Eastbourne, Tunbridge Wells, Birmingham, Grantham, Nottingham, Wakefield, and Hull; and later in the afternoon or evening, to E.N.E. of Strathfield Turgiss, at Norwich, Boston, and Marlborough.

At many other places thunder was heard, or thunder and lightning occurred, but the storm was not experienced.

XX. *Description of a New Ozone-Cage.*

By A. Morton Festing, Esq., F.M.S.

The following is a description of a new ozone-cage which I have had constructed and in operation for some time, and as I find it gives every satisfaction and is not expensive, I trust you will bring it before the Society.

The ozone-cage, a section of which is here given, is composed as follows, viz. A B C D is a circular plate of finely perforated metal, to which two concentric cylinders are attached at A B and C D, with a space of 2 inches between them.

Each cylinder is also finely perforated round its entire circumference in alternate spaces $1\frac{1}{2}$ inch deep, as at *a*, *b* representing the spaces not perforated; and A B and C D are so adjusted with reference to each other, that the spaces at *a* of the former shall oppose those at *b* of the latter and *vice versâ*.

A B has a rim at *h*, also perforated, upon which the instrument

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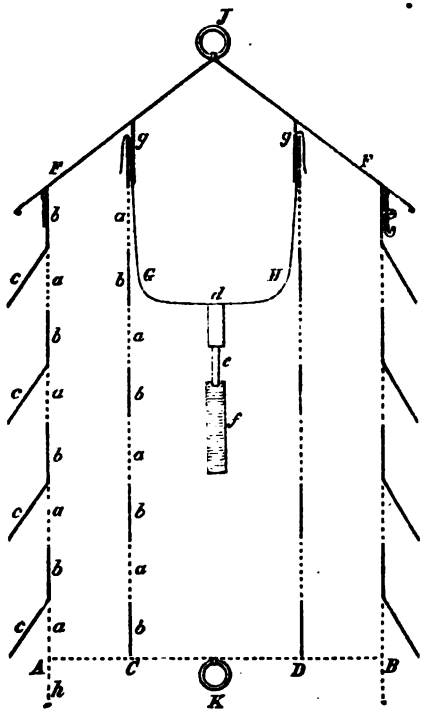
rests when not suspended. *c, c* are *louvres* protecting the spaces at *a, a* in the outer cylinder.

F F is a conical lid attached by a hinge to the outer cylinder; at *g* is a deep rim which fits into the inner cylinder in order to steady it.



G H is the *test-paper suspender*, a strip of metal bent into the required form. *d* is a small tube into which a partially split piece of cane, *e*, is admitted; *f*, the test-paper suspended therefrom.

G H is capable of being detached, and hangs from the top of the inner cylinder, where it is secured by means of *g*.

J and K are two rings used in suspending the *cage*. From the construction of the above instrument it will be seen that the *papers* are entirely protected from sun and rain, and at the same time freely exposed to the air, as a careful examination of the above diagram will show, from which also the mode of using it may be easily seen.

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ANNUAL GENERAL MEETING.

1868, JUNE 17.

The business of the Ordinary Meeting having terminated, the Annual General Meeting was held; and the following Report of the Council was received and read.

REPORT.

The Council have much pleasure in speaking of the great regularity in the observations at established observatories and meteorological stations all over the globe. The almost unbroken continuity of these observations is of the highest importance for future investigations.

Respecting home observations, this regularity may be estimated by the following list of observers whose series were unbroken during the entire year ending December 31st, 1867; also the list of those whose series were broken, and the changes of the staff during the year.

The following are the names of Mr. Glaisher's Corps of observers, whose meteorological observations are complete for the year 1867:—

Samuel Elliott Hoskins, Esq., M.D., F.R.S., F.M.S.	Guernsey.
Matthew P. Moyle, Esq., M.R.C.S.	Helston.
C. Barham, Esq., M.D.	Truro.
J. Ingleby Mackenzie, Esq., M.B., F.M.S.	Sidmouth.
Thomas Mackrell, Esq.	Barnstaple.
J. R. Mann, Esq.	Osborne.
W. Stuart Falls, Esq., M.D., F.M.S.	Bournemouth.
Miss Wilhelmina L. Hall	Eastbourne.
W. G. Barker, Esq., M.D., F.R.A.S., F.M.S.	Worthing.
Thomas Challis, Esq., F.M.S.	Wilton.
John Arnold, M.S.C., F.M.S.	Aldershot Camp.
Charles P. Russell, Esq.	Bath.
Rev. Thomas A. Preston, M.A., F.M.S.	Marlborough College.
George F., Burder, Esq., M.D., F.M.S.	Clifton.
George B. Airy, Esq., M.A., F.R.S., F.R.A.S.	Royal Observatory.
George J. Symons, Esq., F.M.S.	Camden Town.
Rev. Robert Main, M.A., F.R.S., F.R.A.S.	Oxford.
E. Toller, Esq., M.D.	Gloucester.
Hale Wortham, Esq., F.R.A.S., F.M.S.	Royston.
S. Charles Whitbread, Esq., F.R.S., F.R.A.S., F.M.S.	Cardington.

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Samuel H. Miller, Esq., F.R.A.S.	Wisbech.
James Nicol, Esq., M.D.	Llandudno.
John Davis, Esq.	Derby.
John Davidson, Esq.	Holkham.
A. Mercer Adams, Esq., M.D., F.M.S.	Boston.
Thomas Moffat, Esq., M.D., F.R.A.S., F.G.S.	Hawarden.
Rev. R. Tyas, M.A., F.M.S.	Kingsley Parsonage.
George V. Vernon, Esq., F.R.A.S., F.M.S., F.A.S.L.	Manchester.
Thomas Mackereth, Esq., F.R.A.S., F.M.S.	Eccles.
John Hartnup, Esq., F.R.A.S.	Liverpool.
W. Ralph Milner, Esq., M.R.C.S., F.M.S., F.R.M.S., F.A.S.L.	Wakefield.
Joseph Gledhill, Esq., F.G.S., F.M.S.	Halifax.
Henry Denny, Esq., A.L.S.	Leeds.
Rev. W. Sidgreaves	Stonyhurst.
H. W. Thorns, Esq.	Otley.
Fielden Thorpe, Esq.	York.
Rev. F. W. Stow, M.A. F.M.S.	Ripon.
Henry Dodgson, Esq., M.D., F.R.A.S., F.M.S.	Cockermouth.
Thomas Sopwith, Esq., M.A., F.R.S., F.G.S., F.M.S., F.R.M.S.	Allenheads.
Rev. R. Redford, M.A., F.R.A.S., F.M.S.	Silloth.
Isaac Cartmell, Esq., F.M.S.	Carlisle.
Robert Spence, Esq.	North Shields.
John Smyth, Esq., M.A., M.I.C.E.I., F.M.S.	Miltown.
A. Forbes, Esq., F.M.S.	Culloden.

Being forty-four in number.

The following are the names of observers whose observations were not complete for 1867, being generally deficient in one month, owing chiefly to the want of a trustworthy observer, during the absence of the principal observer :—

T. A. Compton, Esq., M.D., B.A., F.M.S., Bournemouth, deficient of one month, viz. September.

C. H. Weston, Esq., B.A., F.R.A.S., F.G.S., Ensleigh, Lansdowne, deficient of one month, viz. March.

W. Haywood, Esq., C.E., Guildhall, deficient of the last four months of the year.

Rev. J. P. Faunthorpe, B.A., F.R.G.S., Battersea, deficient of two months, viz. July and December.

Rev. J. Slatter, M.A., F.R.A.S., F.M.S., Streatly Vicarage, the observations for August could not be printed.

Rev. Prof. J. Matthews, M.A., Lampeter, deficient of one month, viz. August.

James William Jeans, Esq., M.R.C.S., F.R.A.S., F.M.S., the observations for July could not be printed.

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Rev. F. Silver, M.A., F.R.A.S., F.M.S., Norton-in-Hales, the observations for October could not be printed.

Thomas Sopwith, Esq., F.R.S., F.M.S., &c., Bywell, deficient of one month, viz. August.

The alterations in the staff of observers since December 31st, 1866, are as follows:—.

G. F. Burder, Esq., M.D., F.M.S., Clifton, has ceased observing since March 1868, owing to ill health.

The late W. Brooke, Esq., F.R.A.S., F.M.S., who took the observations at Norwich for upwards of twenty years, has been succeeded by C. M. Gibson, Esq., F.M.S.

The observations at Belvoir Castle, conducted by W. Ingram, Esq., F.M.S., have been discontinued since April 1867.

Rev. J. Chadwick Bates, M.A., F.R.A.S., F.G.S., F.M.S., of Castleton Moor Parsonage, has discontinued observing since February 1867.

Owing to the death of Mr. Dolman, the observer under the Rev. Prof. Chevallier, B.D., F.R.A.S., at Durham, the observations have not been forwarded since July 1867.

The late W. G. Barker, Esq., M.D., F.R.A.S., F.M.S., of Worthing, has been succeeded by W. J. Harris, Esq., M.R.C.S.E., F.M.S.

The following are new stations since December 31st, 1866:—

Bournemouth	T. A. Compton, Esq., M.D., B.A., F.M.S., commenced January 1867.
Eastbourne	Miss W. L. Hall, commenced January 1867.
Taunton	Rev. W. Tuckwell, F.M.S., commenced February 1867.
Tunbridge Wells ...	Rev. Fenwick W. Stow, M.A., F.M.S., commenced June 1868.
Weybridge Heath ...	William F. Harrison, Esq., F.M.S., commenced January 1867.
Strathfield Turgiss ...	Rev. C. H. Griffith, M.A., F.M.S., commenced January 1868.
London (21 Dorset square)	Henry E. Segrave, Esq., F.M.S., commenced January 1868.
Gloucester	Ebenezer Toller, Esq., M.D., commenced January 1867.
Nottingham	M. O. Tarbotton, Esq., C.E., F.G.S., commenced January 1868.
Boston.....	A. Mercer Adams, Esq., M.D., F.M.S., commenced January 1867.
Norton-in-Hales.....	Frederick Silver, Esq., M.A., F.M.S., commenced January 1867.
Hull.....	Mr. Edward Peak, commenced July 1867.
Ripon	Rev. Fenwick W. Stow, M.A., F.M.S., commenced January 1867.

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The staff of observers numbers sixty (at the end of May 1868); of these, thirty-six are Fellows of this Society, and twenty-four are not Fellows.

The weekly meteorological observations from the following large towns are still supplied for the Registrar General's weekly Report: —Liverpool, Manchester, Eccles, Birmingham, Wakefield, Sheffield, Leeds, and Newcastle-upon-Tyne. G. F. Burder, Esq., at Clifton, has ceased observing. Mr. E. Peak, at The Park, Hull, commenced observing July 1867: no other alteration has taken place since the last Report. The daily reports are very valuable, frequently showing very different weather at the same time at different parts of the country.

The papers read at the various meetings of the Society, have been numerous; several have been on the Fall of Rain, those by Mr. Glaisher are in respect to its frequency in connexion with the Diurnal Changes of the Magnet, and its frequency and amount at the different Hours of the Day. "On the Influence of the Moon upon the Fall of Rain," by George Dines, Esq.; "On the Rainfall at Natal," by Dr. Mann; and "On the Rainfall at Mauritius," by Charles Meldrum, Esq.

Mr. Dines concludes that the fall of rain is in no way influenced by the changes of the moon, or by the moon's age. It is possible that future investigations may modify this conclusion, when the varying position of the moon in declination &c. may be taken into account.

The paper by Dr. Mann is very valuable, giving, for the first time, accurate data of the rainfall at Natal, and, what is very important, causing a general interest in meteorological questions in that colony, and a desire for further and regular observations, which it is to be hoped Dr. Mann will be able to accomplish.

The paper by Mr. Meldrum shows that doubtless the rainfall has diminished since 1861, and the sufferings of the colony from drought and fever have been great. The Governor, Sir Henry Barkly, has appointed a commission to investigate what connexion, if any, the cutting down of the forests has had with the severe droughts and consequent agricultural distress which have occurred.

With respect to instruments, the only original paper in the year is that by Mr. Ackland; and since then he has produced minimum thermometers by the method therein described, which have been very accurately divided down to zero. It may be mentioned, also, that Mr. Pastorelli has furnished Mr. Glaisher with minimum thermometers which have been accurately divided to zero. Mr. Pastorelli's thermometers were made by making the space of each division a certain fraction less than the adjacent space above, proving that, if sufficient time and care are devoted to the making alcohol thermometers, very accurate instruments can be made.

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The other papers are "On the Climate of Leamington," by S. U. Jones, Esq.: "On some Laws which appear to regulate the Temperature of Months and Seasons," by G. D. Brumham; this paper was one of much patient research, and indicated several laws to predict seasons. Frederic Gaster, Esq., favoured us with an elaborate paper on the Prevalence of Rain, Thunder, Lightning, and Fog on the South and North Atlantic and North Pacific Oceans, and R. C. Cann Lippincott, Esq., with one on the Influence of Ozone; but the author of the latter paper has since expressed a wish for its withdrawal, as he was not aware that the ozone papers were changed at 9 A.M. and 9 P.M.

The Reports which follow, from the several meteorological observatories, and those in relation to new stations in Ceylon, in Natal, and in Mauritius, will enable us to estimate the general progress of meteorology.

ROYAL OBSERVATORY, GREENWICH.—In the arrangements in the Magnetic Observatory but slight alteration has been made in the past year. Allusion was made in our last Annual Report to the circumstance that the S.W. (astronomical) part of the Basement was usually warmer than the east part; and to remedy this, the gas-stove was shifted in an easterly direction, but its effect was insufficient. Since then, by providing a proper flue for the gas-burner which illuminates the horizontal-force scale, near the east end of the room, and maintaining this light more constantly instead of the gas-stove, a good equilibrium of temperature has been obtained, and with such perfect success that there is now no certain difference between the temperature of the two ends of the basement. At the same time the diurnal change of temperature has been brought within very narrow limits; and for testing this numerous observations have been made every day, and the result is, that a change of 1° Fahrenheit in the thermometers exterior to the wooden boxes of the magnetometers is of very rare occurrence. It is almost needless to remark that the change of temperature within the boxes is much less. In the heats of last summer, the highest temperature rose to about 67°, the change in the day having been about 3°: it is hoped in future to reduce these extremes. The lowest in the winter was about 59°.

Magnetic Instruments: Magnetometers.—With respect to the Magnetical Instruments, it may be remarked generally that they are all in excellent state. For quieting the lower-declination magnet when (in experiments) its oval copper damper is removed, a wire intended to dip into water has been provided; but it has not yet been brought into requisition.

The vertical-force photographic magnetometer was revised by Mr. Simms in the winter; its knife-edge was then found to be a little injured. The maintenance of the rule of avoiding to bring magnets within several yards of the vertical-force magnet, seems to have had the desired effect of leaving its magnetical momentum undisturbed.

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For investigating the thermometrical corrections of the horizontal-force and vertical-force magnetometers, experiments were made extending from 1867, December 31, to 1868, February 21, by warming the Magnetic Basement by means of the gas-stove, and (in alternation) leaving the basement exposed to the cold of the external air. At first, this was done only for a few hours at a time, but subsequently it was done for one entire day in one state, and the following entire day in the other state, the pairs of observations being repeated thirteen times. The results were, that the indications of the horizontal-force magnetometer were scarcely changed by change of temperature, while those of the vertical-force magnetometer were considerably changed in the direction opposite to that which the ordinary law of thermal changes would have suggested. It is most probable that the change really produced was principally in the iron frame connecting the magnet with the knife-edge.

The observations with the three magnetometers are reduced, as far as is practicable, to the present time; and the photographic records are regularly time-scaled. The mean westerly declination for the year 1867 was 20° 20′ nearly.

The further reduction of the magnetometer-indications for the period 1858–1863, with reference to diurnal inequalities, solar and lunar, has been generally finished for some time past, and the results are very remarkable. It will be remembered that some time ago a similar reduction was made for the seventeen years 1841–57, of which the numerical and tabular details for the years 1848–57 are printed in the Greenwich Observations 1859, and the curves representing the diurnal solar inequalities, classified as means for nominal months and means for years, for the whole period, are published in the 'Philosophical Transactions,' 1863. It appeared there that the annual curves had gradually undergone a most striking change from 1841 to 1857; the annual mean for 1841, 1842, &c. having the summer or large-curve character, while those for 1856, 1857 had the winter or small-curve character. Now the new reductions show that from 1858 to 1863 the opposite change has taken place in the character of the curves, till finally the forms of the curves for 1863 do not sensibly differ from those in 1841. There is not the slighest trace of decennial or undecennial period, but rather an absolute negation of it.

The observations have also been very carefully grouped with reference to the moon's hour-angle; and the mean for every year exhibits the semidiurnal lunar tide.

The lunar results have also been grouped for years into classes, distinguished by the large solar curves and the small solar curves mentioned above; and the result is, that, in the years of large solar curves, the lunar semidiurnal inequality is considerably greater than in the years of small solar curves. In both sets, the combination of the westerly and the northerly inequalities shows that the lunar magnetic tide (which is synchronous for the two

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ordinates) passes through Greenwich in the direction of a line drawn from the Red Sea to the south of Hudson's Bay.

The cosmical results from these deductions appear to be, that magnetic disturbances, both solar and lunar, are produced mediately by the earth, and that the earth in periods of several years undergoes changes which fit and unfit it for exercising a powerful mediate action.

No progress has been made in the reduction of magnetic storms through the period 1858–63, except in the general selection of days. They exhibit no decennial or undecennial period.

The instrument for the photographic record of the intensity of spontaneous galvanic earth-currents in two directions has received some changes, the galvanometers being remade, the needle-suspension being made more firm, and the acting parts made more accessible; and it is in very efficient condition. Photographic registration was interrupted from 1867, October 25, to 1868, January 30, while the galvanometers were in course of alteration; and all registration has been suspended since the end of April, in anticipation of the change in the courses of the wires, to be presently mentioned.

In regard to the reduction of the observations, a step of considerable importance has been taken. Seventeen days were chosen in the years 1865, 1866, 1867, in which the character of the disturbances was rather bold; the ordinates were measured for a great number of times on each day, and, from the two sets of measures given by the Croydon wire and the Dartford wire, by an easy mathematical process were found the values of the galvanic currents in the directions of magnetic north and magnetic west, which would produce the same effect; and, assuming that such currents, or currents equivalent to them, are passing through the earth below the magnetometers, there was no difficulty, on the well-known laws of transversal magnetic action, in inferring the magnetic effect which they would produce: and the result was, that the agreement between the magnetic effects so computed and the magnetic disturbances really recorded by the magnetometers, was such as to leave no doubt on the general validity of the explanation of the great storm-disturbances of the magnets as consequences of the galvanic currents through the earth. Still there are some points requiring explanation; and, for better elucidation of the whole subject, the following plan is in preparation:—1. To make a similar comparison for all the disturbed days since the apparatus was erected. 2. To examine all the undisturbed days with a view of ascertaining whether there is any clear exhibition of diurnal inequality. 3. To abandon the use of the old wires, each of which terminated at the Royal Observatory, and to adopt two new courses determined by the following considerations:—That the directions of the wires, defined for each wire not by the actual course of the wire, but by the straight line connecting its extreme points where they communicate with earth,

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are to be (as before) nearly at right angles, that the two directions are to intersect near the middle of each, and that this intersection is to be near the Royal Observatory. It is believed that the extent of Greenwich Park would have been sufficient; but the difficulty of carrying wires through the Park is very great; and, relying on the long-experienced liberality of the South-eastern Railway Company and on the zealous assistance of Charles V. Walker, Esq., permission has been solicited and obtained to make one communication from the Angerstein Wharf to the Lady Well Station, and the other from the North-Kent Junction to Morden College. The only unfavourable circumstance is, the great length which must be given to the wires in order to obtain the registration at the Observatory.

The dip-instrument is in the best order, and the needles have been specially revised by Mr. Simms. The mean value of the dip for the year 1867 was 67°·57, obtained by combining the results from all needles: the separate means from needles of different lengths are extremely accordant.

The deflexion apparatus has also been thoroughly revised by Mr. Simms. The mean value of horizontal magnetic force as obtained by the use of this instrument in 1867 is about 3·851 in English units, or 1·776 in French units.

Meteorological Instruments.—The meteorological instruments, whether adapted for photographic registration, mechanical record, or for eye-observation merely, are all in excellent condition. With respect to the instruments mounted in the grounds of the Magnetic Observatory, there appears great probability that, by the projected erection of buildings near the south-eastern corner of the grounds, the free draught of air past the thermometers will be in some measure interrupted, and it is anticipated that an extension of the grounds must be looked forward to.

The electrical apparatus is not efficient, and but little attention has been given to it, as it is hoped soon to supersede it by an instrument on the plan proposed by Professor Sir W. Thompson.

Osler's anemometer, in its modified form, gives a very delicate register of small pressures; but its records of large pressures seem to be larger than those which it would have given in its former state: it cannot be asserted positively that they are larger, nor, if it be so, can the cause be explained; it is certain that the experimental evaluation of the pressure-scale was accurate. Robinson's anemometer was broken in 1868, February 1, after having recorded 1494 miles in the preceding forty-eight hours; it was replaced in a stronger form on February 11.

The collected meteorological observations have not been made practically available; and, during the past year, the additions to the store of records (already rich beyond others) have been extensive. It may not be foreign to our subject to advert more particularly to the meteorological phenomena of the past year, as de-

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duced from these observations; indeed the meteorological history of the year could scarcely be supplied more accurately, or in greater detail, than by reference to these continuous records. The limits of this report, however, forbid all detail; and our remarks must therefore be of the briefest nature. Confining ourselves, then, to the notice of such remarkable occurrences as stand out boldly from the level of normal circumstance, we have first to remark the extraordinary dryness of the atmosphere in 1867, June 27, when the mean degree of humidity for the day was 48, atmospheric saturation being represented by 100. In connexion with this remarkable fact, it may be mentioned that from the 8th of June to the 1st of July the rainfall amounted to 0·08 inch only. We now pass on to notice the most remarkable fall of rain ever recorded in the south-east part of England, viz. on the 26th of July, when rain commenced falling at midnight on the 25th, and fell incessantly for ten hours, giving an amount of 3·18 inches in that time; and the fall for the day was afterwards swelled by 0·49 inch, thus giving for the day's rainfall no less a quantity than 3·67 inches, a greater fall of rain than has ever been recorded in twenty-four hours at the Royal Observatory.

Following upon this great rainfall, a short period of fine, dry, and comparatively cold weather ensued, lasting until August 5; then a warm period of long duration, extending from August 8 to September 14, a period of thirty-eight days, with a mean excess of daily temperature of 3°·1. Heavy rainfalls occurred frequently with this increased warmth, 0·84 inch falling on August 6, 0·76 inch on August 15, 0·58 inch on August 20, 0·72 inch on September 3, 0·60 inch on September 5, 0·47 inch on September 9, and 0·46 inch on September 12.

An increase in barometric readings now followed, accompanied by winds principally from north or compound directions, and also with a depression of temperature to the mean amount of 4°·4 for the twenty-nine days extending from September 15 to October 13. A generally dry and warm period then ensued, and greater depressions in the barometric wave occurred, giving admonition of the approach of the usual winterly gales, the first of which occurred on October 27, the wind (S.W. and S.S.W.) pressing with an extreme force of 30 lbs. on the square foot.

On November 1 a great gloom prevailed for some time after noon, the wind then being S.W.; at 2^h P.M. the direction of the wind changed suddenly from W.S.W. to N., the gloom disappeared, and the temperature fell in a very short time from 60° to 47°. The atmosphere now contained much moisture, and fogs were occasionally prevalent from November 2 to 14. The watch for the recurrent meteor-shower of November 14 was frustrated by cloud; on the morning of the 15th, however, the observers saw some meteors of large size*.

On the 17th of November a violent and persistent gale blew

* *Vide* Proc. Meteor. Soc. vol. iv. p. 50.

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from N.E., with pressures to 27 lbs. on the square foot, and giving a velocity for the day of 664 miles, or at the rate of nearly thirty miles per hour. After this gale the barometer increased with great steadiness, reaching 30·49 inches on November 24, on which day an extremely dense yellow fog prevailed for nearly two hours, and a less dense fog for a considerable additional time. From this day the readings of the barometer decreased, at first steadily, afterwards very rapidly until December 1, reaching the minimum reading, 28·75 inches, on the evening of that day, coincidently with a remarkable change in the direction of the wind from S.W. to N.W. The whole of the day a gale had prevailed from the former direction, with the temperature of the air varying between 50° and 55°, and very humid atmosphere; at the time of the change mentioned above, the temperature was 54°; but immediately it commenced to fall rapidly, and the air became much drier as the temperature declined. By midnight the temperature fell to 39°, and by 9^h A.M. on the 2nd of December to 28°·6, and throughout the remainder of this day the variations of temperature were included between 31°·7 and 26°·1. The day presented a complete contrast to the day preceding, not only as regards temperature, which was no less than 20°·3 (on the mean) lower than the temperature of December 1, but also with respect to the humidity of the atmosphere, the mean degree of humidity for the day being 53, whereas on the 1st of December the mean daily value was 98.

The weather was very cold, and snow fell frequently, from the 2nd of December to the 10th, the lowest recorded temperature being 21°·2 on the 9th, and the mean daily temperature for the period 9°·4 below the average; gales prevailed from W.S.W. on the 15th to the 17th of December, with high temperature; and a remarkably calm and densely foggy period marked the 25th and 26th, the horizontal motion of the air on those days being respectively eighty-nine and sixty-six miles, or at the hourly rate of three miles only.

The month of January 1868 was wet, the rainfall for the month being 2·4 inches in excess as compared with the average quantity, and the greatest day's rainfall occurred on the 22nd to the amount of 1·21 inch; but this fall was limited to the south-east of England. Violent gales, generally from S.W., prevailed on the 13th, 17th, 18th, 19th, 24th, 25th, 30th, and 31st. In the gale of the 31st January, which also continued throughout February 1st, pressures were recorded of 35 lbs. on the square foot, and the instrument for recording the velocity of the wind was broken (as has been mentioned) after recording 1494 miles in the preceding forty-eight hours.

From the beginning of February to the present time, a period of fine warm weather has prevailed, the mean temperatures for each month have been in excess, as compared with the fifty years' average, to the following amounts, February 4°·3, March 2°·4, April 1°·9, and May 4°·4, and the mean excess of the whole pe-

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riod of 135 days, from February 1 to June 14, has been 3°·1. The highest temperature occurred on May 19, and was 87°, and on June 13 and 14 the temperature exceeded 85°. The rainfall has been very deficient throughout this long period, the total amount having been 6·24 inches, of which 1·08 inch fell in the thunderstorm of May 29. (Details of the excessively high temperature &c. on May 19, and of the thunderstorm of May 29, will be found in p. 196).

ROYAL OBSERVATORY, EDINBURGH.—During the past year this Royal Observatory has continued to reduce the observations and systematize the results of fifty-five stations of the Meteorological Society of Scotland; and the condensed statements have been published in the Monthly and Quarterly Returns of the Registrar-General for Scotland.

Throughout the same period the subject of storm-signals has been formally brought to the attention of the Astronomer again and again, by the shipping-interests of Edinburgh and Leith.

During last summer and autumn, the complaint stood,—that though the country was then paying more to the *successors* of Admiral FitzRoy than ever it had paid to him in his day, yet no storm-signals, either in his manner or any other, were being given out. A triumphant expression of this opinion in public, and on a large scale, was carried out at the British Association Meeting in Dundee; but no improvement was seen to follow at the London Office. Winter began, and things did not visibly mend. But at last came the crash; for in December occurred a terrific storm, which actually sent to the bottom of the sea and destroyed far more lives of British subjects than of all those "Abyssinian captives" the mere threatening of whom by the late Emperor Theodore caused the country to send a whole army to the rescue.

Such a calamity could not be ignored: and what lent especial force to this occasion, was the fact (well exhibited on the maps of the daily bulletins of the Imperial Observatory of Paris) that this destructive December storm was peculiarly one of those which, from its normal character and large sphere of barometric action, might most securely have been predicted fully twenty-four hours before hand.

The nominal resumption of the "storm-signals," however, that followed soon after this dire calamity had passed was hailed with delight at Leith as a step in the right direction, and one which men expected would bring back to them Admiral FitzRoy's system, with improvements suggested by time. Before long, though, both merchants and seamen became utterly confounded. They had wanted, they said, STORM-signals, but had got instead signals that were flying nearly every day; signals, indeed, so nu-

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merous, that they were enough, if attended to, to stop the whole trade of the kingdom through six months of the year!

Hence the question is now being discussed, whether the above result is all that the highest meteorological science of the day, directed ably, honestly, and heartily in the cause, can do for the interests and safety of that loyal and important commerce which supplies the funds for the whole Establishment.

Cambridge Observatory.—During the past year the meteorological observations have been taken at 9 A.M. and 3 P.M., but more frequently in heavy storms. A watch was kept for the November meteors, but owing to the unfavourableness of the sky, it being cloudy, very few were observed. The velocity of the wind has been measured by Robinson's anemometer, which has worked satisfactorily; and a new and very sensitive vane has been erected. A short weekly record is sent for insertion in the 'Cambridge Chronicle;' and a yearly summary, with full particulars respecting rainfall, to G. J. Symons, Esq. The observations are taken by Mr. H. Todd.

Radcliffe Observatory, Oxford.—The Meteorological observations at this Observatory have been carried on precisely as in preceding years, and are reduced and discussed in a similar manner. The twenty-fifth volume of the Radcliffe observations, or that for the year 1865, will shortly be published, and will contain, as usual, the meteorological observations for that year.

No alteration of any importance has been made; but it may be mentioned that, in addition to a maximum and minimum self-registering dry thermometer, at the top of the town, there has been placed during the present year, side by side with it, a maximum and minimum wet thermometer, to determine the relative hygrometrical state of the air at that elevation compared with the earth's surface.

It may be also mentioned that the record of the weather is sent every week to two of the Oxford newspapers, the 'Chronicle' and the 'Journal,' and that the information given is found to be very acceptable to the agricultural population in the neighbourhood.

Liverpool Observatory, Bidston.—No material alteration has been made in the meteorological department of this Observatory during the past year. The horizontal movement of the air, direction of the wind, fall of rain, and barometrical pressure have been tabulated for each hour of the day throughout the year. A stronger spring has been applied to Osler's anemometer, in order

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that heavier pressures than heretofore may be recorded. The mean temperature of Liverpool for each day of the year, for the twenty years ending Dec. 31, 1865, has been treated in the way recommended by Mr. Bloxam in vol. iii. no. 21 of the Proceedings of the Meteorological Society; in order to render these results available for comparison at the new Observatory, we took simultaneous readings of maximum and minimum thermometers at the two stations at 9 A.M. each day, throughout the two years ending December 31, 1866. The differences for each day thus obtained have also been treated as recommended by Mr. Bloxam; and the mean temperature at the new Observatory for the twenty years ending December 31, 1865, has been obtained by the application of the above-named differences to the mean temperature for each day of the year as found at the old Observatory.

Glasgow Observatory.—The meteorological observations at this Observatory have acquired an important extension. It is generally known that the Board of Trade has recently assigned the superintendence of the meteorological operations of that department to a Committee of scientific men, at the head of which is General Sabine, President of the Royal Society, and that, among other recommendations of the Committee, has been the establishment of a definite number of stations distributed over the British Isles, furnished with self-recording instruments for ascertaining the continuous variations of the weather, and more especially for obtaining an exact determination of the facts connected with the occurrence of storms.

The Glasgow Observatory having been one of the stations nominated for this purpose, has been recently furnished with a system of self-recording instruments, the operation with which commenced on January 1 of the present year. It is hardly necessary to state that the Government has undertaken to defray the expenses connected with the fitting-up of the instruments and conducting of the subsequent operations.

Natal.—Meteorological ground has been fairly broken for the first time in Natal by the completion of a series of eight years' observation of a very complete character, by Dr. Mann, the Superintendent General of Education in the Colony, from which various abstracts and deductions have been made for this Society from time to time. These observations have been steadily and carefully maintained at Dr. Mann's Observatory, in the capital of the colony, placed 2000 feet high, and some fifty miles inland from the sea. The observations have been recorded and reduced three times daily during the entire period of eight years without a

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single omission. During the last two years, in consequence of Dr. Mann's absence in England, as Special Commissioner of the Colonial Government, the series has been in some degree broken. It has only been found possible during that time to continue the record of rainfall and daily maximum, mean, and minimum temperatures, and of the height of the barometrical column, once daily.

Even this break is very much to be regretted, on account of the important position which this station holds geographically, eight hundred miles east of the Cape of Good Hope, and in the very heart or centre of the region where South Africa revels in an abundant rainfall, and a consequent luxuriant vegetation—characteristics not always associated with the popular idea of this locality.

One reason why there has been this temporary break is, that the charges of the work have hitherto rested upon the private resources of an individual, although the result is really of a national value. The Colonial Government is yet too young to have been able to lend a fostering hand to labour of this abstract and scientific character. But Dr. Mann is looking forward to the time when the advance of the colonial community will enable some fixed establishment to be provided by the Government for extending the base which has thus been secured.

What Dr. Mann desires is the arrangement of three permanent stations, one on the sea-coast near the port of the colony, which is a most remarkable midway station between the Observatories of Cape Town and the maritime one at Maritzburg, the capital, which is 2000 feet high, on the ascending slope of the great continent; and one in a still higher region towards the base of the mountain frontier which divides this maritime district of south-eastern Africa from the comparatively arid tableland of the interior.

It is only by the establishment of these three stations that the law of the rainfall of this very remarkable typical region, and of the periodically alternating movements of the atmosphere, which are expressed in the rain-bearing sea-breeze and the scorching scirocco, and which issue in the maintenance of the frequent thunderstorms, can be efficiently investigated.

The points to which Dr. Mann is especially directing his attention, in this most interesting and instructive field, in conjunction with plans for future work, are: 1st, the cause of the periodic hot dry wind, which can only be determined by observations made simultaneously at stations lying at different distances between the sea and the great heating plains of the interior; 2nd, the diminution of rainfall with height above, and distance from, the sea; 3rd, accurate determination of the hygroscopic condition of the dry wind; 4th, the influence of the rainfall upon the temperatures of the opposite seasons; 5th, the proximate cause of electrical disturbance and manifestation; and

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6th, the influence of the warm sea-currents upon the almost tropical and semiinsular climate of the coast.

It is almost impossible to overrate the value of the meteorological deductions which might be drawn from this region, and so realized for science, if anything like adequate means could be brought to bear steadily upon the investigation. It can scarcely be conceived that the colonial community will overlook the opportunity and the intelligent consideration it may earn for itself in carrying on this not very exacting work, as it moves onwards in the course of social prosperity which seems to be opening out before it.

Mauritius.—The same work is being carried out at this Observatory as last year, viz. the taking of six-hourly observations daily, and, on the 21st of each month, hourly observations of the principal meteorological elements, together with the time-ball service, and the tabulating of observations taken on board ship in the Indian Ocean.

The number of rain-gauges has been increased; there are at the present time twenty-eight stations at which the rainfall is measured.

In consequence of the terrible epidemic which prevailed last year, and which greatly affected the revenue and finances of the colony, the building of a new Observatory (to which allusion was made in last year's Report) was postponed; but His Grace the Secretary of State for the Colonies has sanctioned the purchase of the self-recording instruments intended for it; and there is every reason to believe that they will be at work before our next Annual Meeting.

Mr. Meldrum adds that some of the results of the Observations derived from the log-books of vessels navigating the Indian Ocean are being prepared for publication.

Ceylon.—The Colonial Government have established nine meteorological stations in the island. A complete set of instruments has been forwarded to each of the following places:—Puttalam, Trincomalee, Galle, Newara Elia, Manaar, Jaffna, Batticoloa, Kandy, and Anuradliapurd. These instruments were all examined by Mr. Glaisher. The instruments for three additional stations in Ceylon are being prepared.

A set of instruments is also being prepared for a new station in the Straits Settlements.

Rainfall Investigations.—Steady pursuance of branches of inquiry, noticed in previous Reports, has been the characteristic of the past year, rather than the commencement of fresh branches of inquiry.

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The rain-gauges started in mid-Wales by Mr. Bateman have, we believe, been discontinued since the end of 1867; but those in Cumberland and Westmoreland are still regularly observed. The examination of rain-gauges is continued whenever practicable, and also the extraction of rain-records at the British Museum, and the collection of trustworthy observations from all available sources.

Owing to the removal of Colonel Ward from Calne, and of Mr. Crallan from Uckfield, a fresh *locale* had to be obtained for the experimental gauges; and Mr. Symons considers himself singularly fortunate in having obtained the aid of the Rev. C. H. Griffith, F.M.S., of Strathfield Turgiss, who has undertaken the supervision of both sets, and in whose grounds they are now all at work.

The immense collection of returns (numbering altogether between 15,000 and 20,000 complete yearly records) have always been so tabulated as to facilitate reference, and the discussion of such points as may require elucidation. One such investigation is now almost completed, namely, as to the relative amount of rain falling in different months and seasons at different places. The apparently simple question, "Which is usually the wettest month in the year?" is not very easy of solution; for instance, the answer in London would, perhaps, be July, but in Cumberland, January. The progress and amount of reliance to be placed on the results which are almost ready for publication may be inferred from a brief notice of their history. In the spring of 1867 Mr. Symons took eighty-nine simultaneous records of the rainfall during the ten years 1850–59, and computed the mean fall at each station in each month and (assisted by T. H. Morgan, Esq., F.M.S.) converted the monthly amounts into percentages of the yearly totals. These being classified according to localities, and also according to the total yearly rainfall, gave strikingly consistent results, a brief analysis of which was brought before the British Association at Dundee. Thus much having been ascertained, it was thought necessary to make the investigation as thorough as possible. Mr. Symons, therefore, took the means of no less than 307 decennial tables (embracing, that is to say, 3070 yearly returns, or 36,840 monthly entries). The accuracy of this part of the work having been thoroughly checked, the subsequent stages were entrusted to Mr. Gaster, who has now almost completed the work.

Telegraphic Weather Intelligence.—The Meteorological Office of the Board of Trade has formed a modified code of the FitzRoy storm-signals, and is prepared to issue to ports or fishing-stations notice of serious atmospherical disturbances on the coasts or in the vicinity of the British Islands. This notice is signalled by hoisting a drum, which, however, does not imply *any prophecy*

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of wind or weather, but is intended only to convey information that there is an atmospherical disturbance somewhere which may possibly reach the station where the signal is hoisted.

The Committee for managing the affairs of Lloyd's have published "An Analysis of Wrecks and Casualties reported in 'Lloyd's List' during the year 1867, compared with the year 1866."

The object of the published statistics was to arrange a comprehensive and careful register of losses and casualties which should furnish all available information relating to each accident reported. The Tables comprised all losses and casualties of any importance throughout the world, and had no special reference to any insurance transactions in London or elsewhere.

The following is a Tabular statement of the present strength of the Society:—

	Fellows.			Totals.
	Life.	Ordinary.	Honorary.	
1867, June 19	57	264	10	331
Since elected	+2	+10	...	+12
Since compounded ...	+7	— 7	...	0
Deceased	...	— 4	—3	— 7
Retired	...	— 7	...	— 7
1868, June 17	66	256	7	329

The Society has to regret the death of several of its Fellows; the deceased Fellows are:—

Walter Goodyer Barker, Esq., M.B., F.R.C.S., who was elected into the Society on December 22, 1851.

William Brooke, Esq., F.R.A.S., elected May 7, 1850.

John Mawson, Esq., elected January 18, 1860.

Thomas Pollock, Esq., elected June 15, 1864.

William Brooke, F.R.A.S., was born at Burnham Market, in Norfolk, on August 1, 1795.

His education, at the outset, was such as in remote provincial market-towns in those days was the only one accessible to the middle classes. But he was from his earliest years studious, and

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qualified himself to enter a private school kept by a Mr. Skrimshire, the Incumbent of North Creeks, where he devoted himself to classical reading with so much assiduity as, in a large degree, to make up for his want of a public-school training. He ultimately became assistant to Mr. Skrimshire, and afterwards held a similar position in a private school of far higher pretensions at Peterborough, kept by a Mr. Jenkins, all of whose pupils were scions of the nobility. Here he persevered in his own course of study until about the year 1820, when he was encouraged by his friends to open a school upon his own account at Norwich. And here he laboured until the weight of "three score years and ten" made it needful for him to retire from an occupation in which he had been engaged with much honour and a fair share of success for about five-and-forty years. It was during this period that he turned his attention to natural philosophy as a recreation when the graver tasks of his school were suspended. And not a few of his pupils have acknowledged, with gratitude, the benefit they derived from lectures on experimental science which he was accustomed to give them occasionally or in regular courses. This was before the appointment of Professor Sedgwick as Canon of the Cathedral, and the elevation of Bishop Stanley to the See of Norwich.

These events greatly stimulated the scientific activity of the city; and Mr. Brooke was soon found in the front ranks of a considerable and energetic band of inquirers and observers, a position which he maintained to the end of his life.

His meteorological observations were commenced before 1830; and the records he kept and supplied to the local papers and to scientific journals amounted at last to a vast mass of trustworthy and valuable materials. He joined the Meteorological Society in 1850, and in 1849 he was admitted a F.R.A.S. His health had begun to fail before he relinquished the great work of his life, and the subsequent decline was rapid. He died upon his natal day in 1867, aged 72 years, leaving behind him in a wide circle of friends the memory of a blameless and well-spent life.

Thomas Pollock, elected June 16, 1864, was born at Macclesfield, Cheshire, November 4, 1793. He was the only surviving son of the Rev. Lowthian Pollock, who was for forty-three years Minister of the Unitarian Chapel in that town. Early in life he showed great aptitude for the acquirement of scientific knowledge, and being of a delicate constitution, and the means of the family being very limited, he chose the business of a chemist, as the one most suitable for his future maintenance. He was accordingly apprenticed to Mr. Coates, a chemist of Macclesfield. The highest testimonials to his character and abilities were given him on the expiration of his apprenticeship; and with little else but these and his own energy to trust to, he came up to London in 1815 to seek a situation. After serving as a chemist's assistant for some years,

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he settled finally in 1826 at 129 Fenchurch Street, the sale of a small property bequeathed by his uncle, Mr. Thomas Mather, enabling him to effect the purchase of the business there. In course of time he established himself satisfactorily, and there spent the remainder of his life, attending personally and unremittingly to the business. He died in the old house, after a residence there of forty-three years, February 1, 1868.

Mr. Pollock's simple inexpensive tastes and habits allowed him to apply a large portion of his means to the support of very many charitable institutions. His own peculiarly sensitive nature made him more than ordinarily tender towards the wants and sufferings of the poor and distressed; and his unostentatious timely aid will be missed in many a private family and public society. He was one of the earliest contributors to the Royal Orthopædic Hospital, and was also on the Council, from the meetings of which he was rarely absent. He was also one of the original promoters of the Pharmaceutical Society. For many years his chief amusement consisted in making scientific experiments, the results of some of which appeared in the 'Transactions' of the London Electrical Society, of which he was an original Member. He was present at every meeting of this Society from its foundation in October 1837, till its dissolution in March 1843. He also contributed several papers to the 'Electrical Magazine,' a journal established by Mr. C. V. Walker, on the collapse of the Electrical Society, and to the 'Annals of Electricity.' As early as 1820 he published an "Essay on the Nature and Properties of Colour;" and in 1832 he published, for private circulation, a work entitled "An attempt to explain the Phenomena of Heat, Electricity, Light, &c., on the assumption of One Cause, or Universal Principle," dedicating it to his old and valued friend Jonathan Pereira, M.D. It may be permitted to mention here that a considerable portion of Pereira's 'Materia Medica' was revised by Mr. Pollock, and that his friendly help was often applied for and liberally given on other somewhat similar occasions. In 1854 he wrote a pamphlet on "The Peculiar State of the Atmosphere during the late Epidemic" (Cholera).

Perhaps no one ever cared less for "externals," and certainly no one ever carried out the first great maxims of Christian life more conscientiously. During the whole of his long life he was never known to injure a "neighbour" by word or deed, and he has left behind him a name that will be cherished in the hearts and memories of many friends, amongst whom should be included especially those to whom he was literally and truly "a Friend in Need."

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The following Papers were read at the Ordinary Meetings during the Session 1867–68:—

1. "On the Hourly Frequency and Fall of Rain, in connexion with the Diurnal changes of Magnetic Declination." By James Glaisher, Esq., F.R.S., President.

2. "On an Improved Method of dividing Alcohol- and other Thermometers." By William Ackland, Esq.

3. "On the Erection of Mr. Cator's Anemometer at Beckenham." By C. O. F. Cator, Esq., M.A., F.M.S., Secretary.

4. "Meteorological Results deduced from Daily observations taken at Leamington during the years 1862, 1863, 1864, 1865, and 1866; latitude 52° 17′ N., longitude 1° 32′ W., height above the sea-level 195 feet." By S. Urwick Jones, Esq., F.M.S.

5. "On the Frequency of Rain at the different Hours of the Day in the several Months and Seasons of the Year." By James Glaisher, Esq., F.R.S., President.

6. "Meteoric Shower of November 13–14, 1867."

7. "On Changes of Mean Temperature in Long Periods." By Herr Lucas. Translated by W. T. Lynn, Esq., B.A., F.R.A.S.

8. "On an Aerolite seen at the Cape of Good Hope." By G. W. Bennett, Esq.

9. "On some of the Laws which appear to regulate the Temperature of Months and Seasons." By G. D. Brumham, Esq.

10. "Accounts of the Earthquake which visited the Virgin and adjacent Islands on November 18, 1867."

11. "On the Reduction of Barometer-Readings of Cistern-Barometers with variable level." By Dr. C. Jelinck, Member of the Imperial Academy of Sciences at Vienna. (Read at the Meeting of the Imperial Academy on the 10th of November, 1867.) Translated by W. T. Lynn, Esq., B.A., F.R.A.S.

12. "On the Prevalence of Rain, Thunder, Lightning, and Fog on the South Atlantic, North Atlantic, and a part of the North Pacific Oceans." By Frederic Gaster, Esq., F.M.S., Librarian.

13. "On the Fall of Rain at the different Hours of the Day, in the several Months and Seasons of the Year." By James Glaisher, Esq., F.R.S., President.

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14. "On the Influence of the Moon upon the Fall of Rain in respect to her Age." By George Dines, Esq., F.M.S.

15. "On the Rainfall in Natal, South Africa." By R. J. Mann, Esq., M.D., F.R.A.S., F.R.G.S., &c., Superintendent of Education in the Colony.

16. "Influence of the Sun's Hour-Angle on the Development of Ozone." By R. C. Cann Lippincott, Esq., F.M.S.

17. "On a Self-recording Anemometer." By S. B. Howlett, Esq.

18. "On the Rainfall of Mauritius." By Charles Meldrum, Esq., M.A., F.M.S.

19. "Notes on the unusual Heat and Great Dryness of the Atmosphere on May 19, 1868, and on the remarkable Thunderstorm of May 29, 1868, as observed at Greenwich." By W. C. Nash, Esq., F.M.S.

20. "Description of a New Ozone-Cage." By A. Morton Festing, Esq., F.M.S.

Resolved:—

That the Report which has just been read be received and adopted, and that it be printed and circulated among the Fellows of the Society.

Proposed by L. P. Casella, Esq.
Seconded by H. S. Tabor, Esq.

That the cordial and best thanks of the Meteorological Society be communicated to the Council of the Institution of Civil Engineers for having granted the Society free permission to hold their Meetings in the rooms of the Institution during the Session that has just ended.

Proposed by G. J. Symons, Esq.
Seconded by G. Dines, Esq.

That the best thanks of the Society be given to Mr. Cator for his services as Secretary, with regret that his engagements prevent his being able to retain the office longer.

Proposed by A. Brewin, Esq.
Seconded by H. S. Eaton, Esq.

The President having appointed Mr. Pastorelli and Dr. Mann as Scrutineers; a ballot was then taken, and the following list of Members, prepared and proposed by the retiring Council, was received and adopted as Council and Officers for the twentieth Session, 1868–69:—

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THE OFFICERS AND COUNCIL

OF

THE METEOROLOGICAL SOCIETY,

ELECTED 17TH OF JUNE, 1868.

President.

J. GLAISHER, Esq., F.R.S., F.R.A.S., &c.

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JOHN W. TRIPE, Esq., M.D., *Sanitary Department, Town Hall, Hackney*, N.E.

Foreign Secretary.

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G. J. SYMONS, Esq.
C. V. WALKER, Esq., F.R.S., F.R.A.S.

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The Treasurer's Account for the year 1867.

Receipts.

1867.		£	s.	d.	£	s.	d.
Jan. 1.	To Balance of last year	.....			2	18	0
April.	Dividend on £900 New 3 per Cents	13	5	6			
Oct.	Do. £1000 do.	14	15	0			
	DIVIDENDS	28	0	6			
	Subscriptions for 1864	1	0	0			
	Do. for 1865	6	0	0			
	Do. for 1866	15	0	0			
	Do. for 1867	190	4	0			
	Do. for 1868	1	10	0			
	ANNUAL CONTRIBUTIONS	213	14	0			
	Seven Compositions:—						
Mar. 14.	Fr. M. Williams, Esq., M.P.						
„ 26.	A. Carpenter, Esq., M.D.						
„ 29.	Royal Artillery Institution						
April 17.	W. P. Dymond, Esq.	70	0	0			
May 1.	H. E. Westcar, Esq.						
Aug. 6.	Warington Smyth, Esq.						
„ 19.	Warren De la Rue, Esq.						
	CONTRIBUTIONS	283	14	0			
	Sales of Proceedings, &c.	6	12	3			
	Total RECEIPTS				318	6	9
					£321	4	9

1868.					
Jan. 1.	To Balance				£14 0 2

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The Treasurer's Account for the year 1867.

Expenditure.

1867.			£	s.	d.	£	s.	d.
Jan. 16.	By Proceedings,	No. 28	15	9	0			
Feb. 20.	Do.	No. 29	15	18	0			
Mar. 20.	Do.	No. 30	17	1	3			
April 17.	Do.	No. 31	15	6	6			
June 19.	Do.	No. 32	24	19	6			
Nov. 20.	Do.	No. 33	27	19	0			
	PROCEEDINGS, Six Nos.		116	13	3			
Dec. 31.	Registrar-General's Reports		5	12	0			
	PRINTING					122	5	3
	Stationery		7	13	6			
	Postage Stamps		7	0	0			
	Stamped Cheques		0	2	6			
	Petty Expenses of Secretary and Editor		4	12	0			
	Attendance and Refreshments		8	18	4			
	EXPENSES					28	6	4
	Assistant to Editor of Proceedings		52	0	0			
	Collector's Commission		10	14	0			
	SALARIES					62	14	0
	Total PAYMENTS					£213	5	7
June 19.	£60 New 3 per Cents	93¼	56	2	0			
Aug. 29.	£40 Do.	94⅝	37	17	0			
	Investment of Compositions					93	19	0
	BALANCE					14	0	2
						£321	4	9

HENRY PERIGAL, *Treasurer.*

W. C. NASH, *Auditor.*

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The following Resolution was then put to the Meeting and carried unanimously:—

That the thanks of the Society be given to the Officers for their services during the Session that has now closed.

Proposed by Dr. Mann.
Seconded by W. C. Nash, Esq.

NOTICE.

Session 1868–69.

The Meetings will be held on the Third Wednesday in the months, at 25 Great George Street, Westminster, S.W., by the kind permission of

The Council of the Institution of Civil Engineers.

Ordinary Meetings at 7 P.M.

1868.	November	18	1869.	March	17
1869.	January	20	„	April	21
„	February	17	„	June	16

The Annual General Meeting will be held after the Ordinary Meeting on June 16.

Council Meetings at 6 P.M.

1868.	October	21	1868.	March	17
„	November	18	„	April	21
1869.	January	20	„	June	16
„	February	17			

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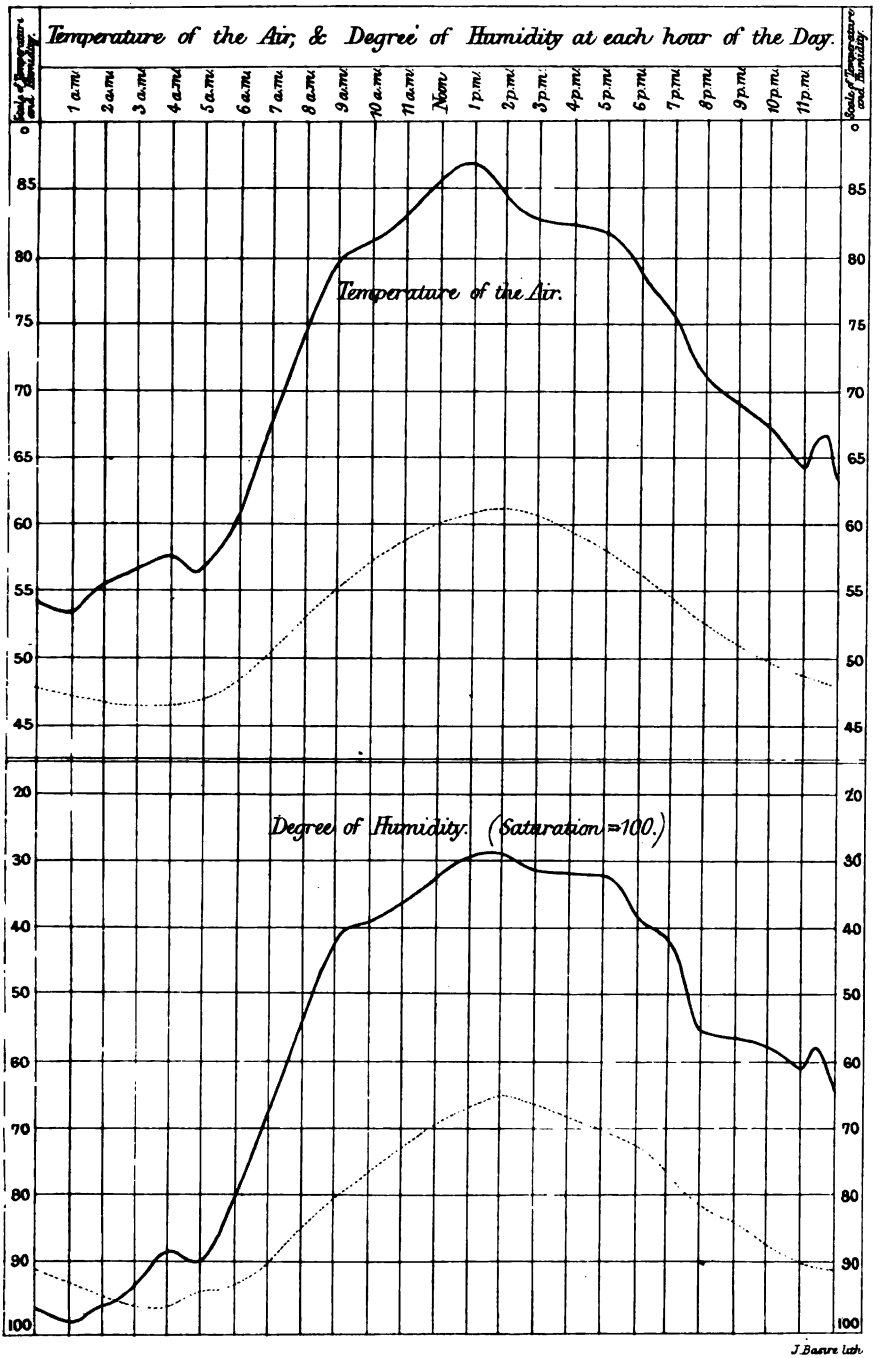
Diurnal Variations of Temperature and Humidity on May 19th 1868, shown thus ——

Diurnal Curves of Approximate Mean Temperature and Degree of Humidity ·····



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ORDINARY MEETINGS
OF
THE METEOROLOGICAL SOCIETY,
SESSION 1868–69,

25 GREAT GEORGE STREET, WESTMINSTER, S.W., AT 7 P.M.

1868. November	18	1869. March	17
1869. January	20	„ April	21
„ February	17	„ June	16

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Vol. IV.] [No. 39.

PROCEEDINGS

OF

THE METEOROLOGICAL SOCIETY.

EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

1868, NOVEMBER 18.

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PROCEEDINGS

OF

THE METEOROLOGICAL SOCIETY.

EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

Vol. IV. 1868, NOVEMBER 18. [No. 39.

JAMES GLAISHER, Esq., F.R.S. &c., President, in the Chair.

Clement Smith Barter, Esq., M.B. Lond., F.R.C.S. Eng., 27 Paragon, Bath;
A. S. Hobson, Esq., 3 Upper Heathfield Terrace, Turnham Green;
Charles Augustus Langton, Esq., M.A. Cantab., 14 Montpelier Street, Brighton;
Benjamin Loewy, Esq., 17 Shaftesbury Villas, Richmond, S.W.;
The Honourable Rollo Russell, Pembroke Lodge, Richmond, S.W.;
were balloted for and duly elected Fellows of the Society.

The Name of one Candidate for admission into the Society was read.

XXI. *On the Rainfall of Cobham and Chiswick.*

By G. Dines, Esq., F.M.S.

In March last, a paper which I had prepared, relating to the Moon's Influence upon Rainfall, was read before the Society. The Rainfall Tables from which that paper was composed were taken from a journal kept by Miss Molesworth, of Cobham Lodge, Surrey; but, owing to the rainfall not having been always entered daily,

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I was obliged to omit some moons from my calculations. With the intention of more fully investigating the subject, I have obtained through the kindness of Mr. Thompson, late of the Royal Horticultural Society's Gardens, Chiswick, a complete register of the rainfall at that place for forty years, 1826–1865. The total rainfall being always entered at Cobham, this has enabled me to fill in and to apportion, with tolerable accuracy, the days that were deficient in that journal, so that I have now the daily rainfall at these two places for forty years. These have been compared, and all places that appeared doubtful or incorrect referred back to the original journals. I think, therefore, it may be fairly assumed that these Tables, without pretending to perfect accuracy, are as correct as can be obtained from any private sources in this country for so long a period. The rainfall at Cobham has been taken in a 5-in. gauge, 1 foot above the ground, and 117 feet above the Ordnance datum; that at Chiswick in a 12-inch gauge, $2\frac{3}{4}$ feet above the ground, and 26 feet above the Ordnance datum. As a comparison of the rainfall at these two places may be interesting, I have given the results in as brief a manner as possible in the following Tables.

TABLE I.

	Rainfall at Cobham.				Rainfall at Chiswick.			
	Total of Forty Years, 1826–65.	Monthly Average of Forty Years.	Per-centage for each Month.	Daily average of the Forty Years.	Total of Forty Years.	Monthly Aver-age.	Per-centage for each Month.	Daily average of the Forty Years.
	ins.	ins.	ins.	in.	ins.	ins.	ins.	in.
January.....	71·78	1·794	7·52	·0579	66·38	1·659	7·05	·0535
February ...	56·29	1·407	5·90	·0498	55·05	1·376	5·85	·0487
March	56·79	1·420	5·95	·0458	55·05	1·376	5·85	·0444
April	64·36	1·609	6·75	·0536	60·81	1·520	6·46	·0507
May	78·08	1·952	8·19	·0630	79·16	1·979	8·41	·0638
June	78·72	1·968	8·25	·0656	80·90	2·022	8·60	·0674
July	91·09	2·277	9·55	·0734	94·50	2·362	10·04	·0762
August	90·32	2·258	9·47	·0728	96·90	2·422	10·29	·0781
September ...	97·66	2·441	10·24	·0814	98·48	2·462	10·46	·0821
October	112·59	2·815	11·81	·0908	109·25	2·731	11·61	·0881
November ...	92·35	2·309	9·68	·0769	87·73	2·193	9·32	·0731
December ...	63·79	1·595	6·68	·0514	57·03	1·425	6·06	·0460
Sums	953·82	23·845	100·00	·0652	941·24	23·527	100·00	·0644

The next Table shows the number of days on which no rain was registered, and also the number of days on which different quantities of rain fell.

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TABLE II.

The Number of Days at Cobham on which	In Jan.	In Feb.	In Mar.	In Apr.	In May.	In June.	In July.	In Aug.	In Sept.	In Oct.	In Nov.	In Dec.	Total.	Yearly Average.
No rain was registered.....	686	621	702	698	717	670	713	717	637	613	598	665	8037	200·925
in. in.														
·01 to ·10 of rain registered ...	325	325	338	288	283	298	290	277	283	321	335	357	3720	93·000
·10 „ ·20 „ „ ...	110	91	111	108	107	113	97	95	115	120	105	113	1285	32·125
·20 „ ·30 „ „ ...	51	53	48	50	48	45	49	49	52	61	67	48	621	15·525
·30 „ ·40 „ „ ...	32	20	22	24	37	27	24	34	45	41	32	31	369	9·225
·40 „ ·50 „ „ ...	16	10	9	12	19	16	24	19	24	32	29	10	220	5·500
·50 „ ·60 „ „ ...	4	2	6	9	13	11	9	21	13	12	13	7	120	3·000
·60 „ ·70 „ „ ...	9	7	1	6	5	5	10	6	10	12	8	7	86	2·150
·70 „ ·80 „ „ ...	4	...	1	3	4	7	6	9	9	9	3	1	56	1·400
·80 „ ·90 „ „ ...	1	...	1	1	3	1	6	3	5	7	2	...	30	·750
·90 „ 1·00 „ „ ...	1	...	...	...	2	...	2	1	...	4	6	1	17	·425
1·00 „ 1·10 „ „ ...	1	...	1	1	...	1	...	3	3	4	1	...	15	·375
1·10 „ 1·20 „ „ ...	...	...	...	...	1	...	3	2	1	2	...	...	9	·225
1·20 „ 1·30 „ „ ...	...	1	...	...	...	4	...	2	...	...	1	...	8	·200
1·30 „ 1·40 „ „ ...	...	...	...	...	1	...	1	1	1	1	...	...	5	·125
1·40 „ 1·50 „ „ ...	...	...	...	...	...	...	2	...	1	...	...	...	3	·075
1·50 „ 1·60 „ „ ...	...	...	...	...	...	...	2	...	...	...	...	...	2	·050
1·60 „ 1·70 „ „ ...	...	...	...	...	...	...	1	1	...	...	...	...	2	·050
1·70 „ 1·80 „ „ ...	...	...	...	...	...	1	1	...	1	1	...	...	4	·100
1·80 „ 1·90 „ „ ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1·90 „ 2·00 „ „ ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2 ins. and upwards „ ...	...	...	...	...	...	1	...	...	...	...	...	...	1	·025
Total number of Days	1240	1130	1240	1200	1240	1200	1240	1240	1200	1240	1200	1240	14610	365·250

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TABLE II. (*continued.*)

The Number of Days at Chiswick on which	In Jan.	In Feb.	In Mar.	In Apr.	In May.	In June.	In July.	In Aug.	In Sept.	In Oct.	In Nov.	In Dec.	Total.	Yearly Average.
No rain was registered	719	658	757	696	730	677	715	725	648	617	631	718	8291	207·275
in. in.														
·01 to ·10 of rain registered	309	283	290	310	265	294	278	243	272	308	315	317	3484	87·100
·10 „ ·20 „ „	103	92	101	93	108	92	89	106	107	119	98	112	1220	30·500
·20 „ ·30 „ „	50	50	47	47	50	53	59	52	64	72	56	46	646	16·150
·30 „ ·40 „ „	24	24	23	23	32	26	33	38	34	42	41	29	369	9·225
·40 „ ·50 „ „	12	11	12	12	23	18	23	24	30	22	18	8	213	5·325
·50 „ ·60 „ „	8	6	3	9	12	12	10	18	14	27	17	3	139	3·475
·60 „ ·70 „ „	4	3	5	5	10	12	6	12	14	12	12	5	100	2·500
·70 „ ·80 „ „	6	1	1	3	4	6	10	5	4	6	2	1	49	1·225
·80 „ ·90 „ „	4	1	...	...	1	5	3	6	6	7	4	...	37	·925
·90 „ 1·00 „ „	1	1	...	...	2	3	2	3	1	2	1	...	16	·400
1·00 „ 1·10 „ „	...	...	...	...	...	1	2	3	1	5	2	...	14	·350
1·10 „ 1·20 „ „	...	...	1	1	2	...	3	2	...	...	1	1	11	·275
1·20 „ 1·30 „ „	...	...	...	...	1	...	2	1	2	...	2	...	8	·200
1·30 „ 1·40 „ „	...	...	...	...	...	...	3	2	...	...	...	...	5	·125
1·40 „ 1·50 „ „	...	...	...	1	...	1	1	...	1	...	...	...	4	·100
1·50 „ 1·60 „ „	...	...	...	...	...	...	...	...	1	...	...	...	1	·025
1·60 „ 1·70 „ „	...	...	...	...	...	...	1	...	1	...	...	...	2	·050
1·70 „ 1·80 „ „	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1·80 „ 1·90 „ „	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1·90 „ 2·00 „ „	...	...	...	...	...	...	...	...	...	1	...	...	1	·025
2 ins. and upwards „	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total number of Days	1240	1130	1240	1200	1240	1200	1240	1240	1200	1240	1200	1240	14610	365·250

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Taking the Average of Forty Years, the	At Cobham	At Chiswick.
	days.	days.
No. of days per annum on which rain was registered, was	164·325	157·975
On which ·10 and upwards was registered, was	71·000	70·875
" " ·20 " " "	39·200	40·375
" " ·30 " " "	23·675	24·225
" " ·40 " " "	14·450	15·000
" " ·50 " " "	8·950	9·675
" " ·60 " " "	5·950	6·200
" " ·70 " " "	3·800	3·700
" " ·80 " " "	2·400	2·475
" " ·90 " " "	1·650	1·550
" " 1·00 " " "	1·225	1·150

If Table I. be examined, it will be seen that the rainfall registered at Cobham, from October to April inclusive, has exceeded that at Chiswick, but during the other months it is the reverse: if tried with short periods this rule does not always apply; but as it very generally does, the question arises, To what is this difference owing? Is it to the size of the gauges, or the manner in which they are placed, or to the situation of the two places?—Chiswick being much lower and in a more extended valley than Cobham. These questions can probably be best answered by a comparison made at other places similarly situated.

The number of rainy days registered at Cobham is considerably in excess of those at Chiswick: this may partly arise from a difference in the taking of small rainfalls (which has been noticed by Mr. Symons in his British Rainfall for 1867, p. 28); for if the number of days without rain be added to those on which less than one-tenth of an inch was registered, it gives for the forty years at Cobham 11,757 days, and at Chiswick 11,775 days—a trifling difference, not amounting to half a day per year.

If the number of days in each month be taken into consideration, April, with its proverbial character for showers, has had at Cobham fewer rainy days than any other month; at Chiswick March stands first in this respect. On the contrary, October at both places has the greatest number of rainy days; and the total rainfall for that month may be considered, roughly, double that of February and March.

A fall of rain exceeding 2 inches in the day has only been registered once during the forty years, viz. at Cobham on the 20th of

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June, 1857; the fall at Chiswick on that day was ·68 in. This can hardly be considered a fair average of the district around London, as I have twice in the last twelve years registered that amount—at Wandsworth, on Whit-Sunday, June 12, 1859, and at Windlesham, August 23, 1865; and in order to show the difference which a few miles makes in the amount of rainfall, the following Table is given: it must be observed, however, that the rainfall in June was from a thunderstorm, that in August from steady rain, and one likely to be general over a large district:—

Rainfall.	At Cobham.	At Chiswick.	At Wandsworth.	At Windlesham.	At Camden Town.	At Greenwich.
	in.	in.	ins.		in.	in.
June 12, 1859	·76	·57	2·29	No record.	1·01	·23
August 23, 1865 ...	1·20	·82	1·03	ins. 2·01	1·01	1·79

The days alluded to commenced at 8 A.M. and 9 A.M.; but if the day be supposed to commence at any hour, a fall of 2 inches in the twenty-four hours is by no means so unfrequent, and has already occurred at Cobham once this year, on July 12th, when 2·27 inches of rain fell.

The three days on which the least rain fell during the forty years were as follows:—at Cobham, March 18, 0·67 in., February 16, 0·71 in., and December 21, 0·84 in.; at Chiswick, February 16, 0·59 in., March 24, 0·67 in., and March 18, 0·79 in. The three days of greatest rainfall were as follows:—at Cobham, October 22, 6·48 ins., August 14, 6·13 ins., and September 26, 5·99 ins.; at Chiswick, August 2, 6·06 ins., October 22, 6·03 ins., and September 28, 5·93 ins. Taking seven days in succession, the time of least rainfall at both places has been from March 18 to the 24th inclusive; at Cobham the rainfall on those days was 9·82 ins., at Chiswick 9·44 ins. The seven days on which most rain fell were from October 22 to the 28th, during which time 32·67 ins. were registered at Cobham, 31·90 ins. at Chiswick. Excessive rain is generally supposed to be accompanied by a low barometer; but as this indicates wind as well as rain, the greatest rainfall occurring on the days named is one of considerable interest, as it was on October 26, 1859, that the 'Royal Charter' was wrecked; and since that time the question has been much discussed whether what

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has been called the 'Royal Charter' gale is periodic or not. If each day's rainfall be taken and added to that of the two days preceding and following, and then divided by 5 for the day's average, the same result is arrived at: there is only one other seven days in the year at all comparable with the days named; and that is from September 23 to 29, when 29·71 ins. were registered at Cobham, and 28·82 ins. at Chiswick.

I cannot conclude without expressing my thanks to Miss Molesworth, and to Mr. Thompson, as it is to their journals, continued with so much perseverance at a time when meteorology was much less thought of than at present, that I am wholly indebted for the materials from which this paper is composed.

XXII. *On an exceptionally Heavy Rainfall and a Destructive Flood in the Colony of Natal, in the Month of August* 1868.

By R. J. Mann, Esq., M.D., F.R.A.S., F.R.G.S., F.M.S.

On the evening of Friday the 28th of August, 1868, a heavy thunderstorm burst on the coast district of the colony of Natal at 5 o'clock; and with the thunderstorm rain began to fall. The rainfall on this occasion continued until the morning of Monday, August 31—that is, for about sixty-four hours. At 9 o'clock in the morning of August 31st the rain ceased, and the sky cleared.

During these sixty hours, the fall at my observatory at Maritzburg, 2095 feet above the sea, was ten inches and four-fifths. On the coast, at Mr. Lamport's plantation, the fall, measured by a rain-gauge supplied to Mr. Lamport by myself, was 16·54 inches. That is to say, on this occasion the rainfall within sixty-four hours exceeded one-third of the mean rainfall for the year derived from a period of eight years.

The register of the rainfall at my observatory at Maritzburg, for each twenty-four hours of the days involved, the estimate being made at 9 in the morning of each day for the previous twenty-four hours, was:—

	ins.
Saturday, August 29, 9 A.M.	1·05
Sunday, August 30, 9 A.M.	4·26
Monday, August 31, 9 A.M.	5·50
Total	10·81

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At the commencement of the fall the wind was blowing from the south-west. On the afternoon of the 29th the wind veered to the south, and came in squalls, the rain then falling the most heavily. In the evening it was blowing from the south-south-east and south-east. With the clearing of the sky it came from the east-north-east.

The barometer, however, sufficiently indicated the movement of the air, and the true cause of the excessive fall. The readings at my observatory, for the several days concerned in the fall, were:—

	At 9 in the morning.	
	Barometer.	Thermometer.
	ins.	°
August 27	27·866	62·5
„ 28	27·920	60·1
„ 30	28·106	58·5
„ 31	28·068	56·0

The barometer rose during the rainfall, and fell at its cessation.

I have before had occasion to remark, in connexion with the meteorology of Natal, that a high barometer means a movement of cool sea-air from the south-east towards the north-west, and that a low barometer indicates a movement of warm land-air from the north-west towards the south-east. Now, it is a noteworthy fact that these occasional excessive rainfalls on the coast of Natal occur in the dry and not in the wet season of the year. The most remarkable flood previous to this one happened in the month of April 1856, essentially a dry month. In my notes of the rainfall in Natal, presented recently to the Society, I recorded a fall of 8·97 ins. on the coast in seven days. This occurred from the 5th to the 11th of June, 1865, also a dry month. The fall now under notice occurred in the month of August, a dry month. These are the only three occasions on which excessively heavy falls and floods have occurred within the range of my own experience.

The reason why these exceptionally heavy falls occur in the dry season is obvious enough. They are due to the movement of large masses of air, fully and heavily saturated with moisture, from the vast ocean space on the south-east, at a time when the temperature over the rapidly rising land which is first reached is at its lowest. If the same thing occurs at the season when the land-temperature is at its highest, the moist air does not get itself chilled and its saturation-point lowered in the same energetic

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way, and therefore the deposition of water from it is not so copious or so sustained.

It will be observed that the law which has already been placed pointedly before the Meteorological Society, namely, diminution of fall in this region, with heights at least amounting to 2000 feet, has been observed in all these three instances of flood. In the flood of April 1856, the

Coast fall was reported to be	27 inches.
And the Maritzburg fall (some forty miles inland, in a direct line, and 2095 feet high) was	11 „

In June 1865

The coast fall was	8·97 inches.
The fall at Maritzburg was.....	1·23 „

In August 1868

The coast fall was	16·54 „
The fall at Maritzburg was.....	10·81 „

In all these instances the rivers near the coast were flooded to an extreme degree, while the rivers of the higher region from sixty to one hundred miles inland were very slightly swollen.

The sea-rains at Natal are generally unaccompanied with thunder. But on the occasion of these violent floods the thunderstorm is generally developed; the rain on the evening of the 28th of August, 1868, was ushered in by a somewhat violent thunderstorm. This is simply an accident of the occurrence on these occasions; whenever the deposit of aqueous vapour in the atmosphere is *very copious* and *very sudden* electrical manifestation necessarily takes place.

In June 1865 the flood on the coast was not sufficiently sudden or large to be attended with very disastrous consequences. In April 1856 it was so. Upon that occasion the rain commenced at 2 o'clock in the afternoon of Sunday, and continued until the following Thursday morning. The river Umgeni, three miles to the north-west of the port of Durban, overflowed all the flats near its mouth; and the rise of the water in that situation was variously estimated at from 22 to 28 feet. The sea-beach near the mouth of this river was covered with trunks of trees, deposits of reed, and dead oxen brought down by the flood. At that period all the bridges in the colony were rude and comparatively inexpensive timber structures; but several of these were swept away.

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The sugar-planters suffered heavy loss, because at this time the low flats near to the river-mouths were the favourite situations for the planting of cane.

Upon the present occasion the loss to the planters has been comparatively less, but the damage to public works relatively larger, on account of these being in a more developed and advanced state than they were in the year 1856. The entire loss to the colony is estimated as being probably within £100,000. The loss to public works, principally affecting roads and bridges, is considered to be about £40,000. The most important portion of this is due to the sweeping away of a very fine iron bridge, which had been erected, at a cost of £19,000, over the river Umgeni as lately as the year 1864.

This bridge formed the communication between the port of Durban and the county Victoria, where sugar- and coffee-planting have been most developed; and it was therefore a very important work. As much as 5500 tons of sugar, 200 tons of coffee, and 40,000 sacks of maize would have passed over the bridge this season. The bridge consisted of iron girders, resting on cylindrical iron piers which were screwed to pile beds, the piles being driven 12 feet into the bed of the river, and was 900 feet long. Its size, and general appearance, are represented in the annexed woodcut, from a photograph taken shortly after the opening of the bridge, on the 22nd of September, 1864. The height of the girders above the river was pitched at what was believed to be a greater elevation than the rise of the flood of 1856.

The water rose rapidly in the Umgeni, on the occasion of this last flood, through the Saturday and Sunday. On the Sunday a colonist, named Henry Fell, and twenty-two native labourers were occupied near the banks of the river in this neighbourhood, when they saw the water coming down upon them along the river-channel like a great wall—a phenomenon so frequently alluded to in connexion with the filling of African rivers. They were perfectly unable to clear the rush of the stream, and climbed a tree which chanced to be near them, and were only rescued from their perilous and precarious refuge, after nine hours' exposure, by an act of considerable bravery and daring. They were all taken from the tree by a boat brought to the spot after some difficulty, and manned by two neighbours, named Watson and Keal. At 4 o'clock on Sunday afternoon the water was within 2 feet of the bottom of the girders. At 7 o'clock it was within 1 foot of them.

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At midnight the water was 1 foot above the girders. At 4 o'clock on the Monday morning, the current was running between 10 and 12 knots where the bridge had stood on the previous day: only two girders and three pillars remained of the structure; all else had been swept away in the torrent.

Six other bridges, besides this large one over the river Umgeni, near its mouth, were swept away. One only of these was as high inland as the capital city, Maritzburg. This was an inexpensive timber structure, and was carried away bodily, and cast ashore almost uninjured upon a convenient flat some distance down the stream. The Maritzburg river, the Umzimdusi, rose between 20 and 25 feet. The Surveyor-General, Dr. Sutherland, estimates that the water in its channel was at its highest at midday on the 31st, and that it was then 6 inches lower than the highest point the flood attained in 1856. The fall of rain a short distance up this river, at Dr. Sutherland's residence, was 12·75 ins. up to noon on the 31st. The record of 10·81 ins., previously given as the fall at my own observatory, was, no doubt, made up to 9 o'clock on the same morning. Dr. Sutherland states that the rain ceased with him at noon. At the height of the flood, every cubic foot of water in this river contained nearly one ounce of solid substance.

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The other bridges destroyed were all at a lower level, and nearer to the coast, than this one. The bridges of the higher rivers are nearly all uninjured.

A heavy sea was breaking on the coast at the conclusion of the rainfall; but, upon an occasion like this, sea-structures have a great advantage over river-structures, on account of the unrestricted area of the ocean basin. The north pier of the harbour-works in course of construction, which now extends a long distance into the sea, has not sustained any damage.

One of the pilots on the low sandy point near the entrance of the harbour marked the rise of the water on this flat, lying between the mouth of the Umgeni and the inner bay, as being 18 inches higher than it was in the flood of 1856.

XXIII. *November Meteors*, 1868.

By James Glaisher, Esq., F.R.S., President.

Although little hope was entertained of the reappearance of the November meteors this year, at least as regards this portion of the globe, it is gratifying to be able to state that the diligent watch maintained at the Royal Observatory has been fraught with most interesting and unexpected results. This is doubly gratifying when we consider the almost persistent cloudiness of the sky, to which cause, I believe, it may be attributed that so few accounts have been received from other districts.

The circumstances of observation at the Royal Observatory were the following:—

The observers (Messrs. Nash, Schultz, and Farncomb) were watching throughout the evening of the 13th and morning of the 14th; but until near 2 A.M. the sky remained overcast. At 2 A.M. the sky suddenly cleared and remained clear for nearly an hour, and the observers were astonished to find that large meteors of the usual November character were abundant. In this hour the positions, &c., of forty-four meteors were noted, a number bearing a very small proportion to the number actually seen. The uncertain nature of the night, however, induced the observers to confine their attention to the record of particular meteors rather than to observation of the actual numbers which appeared, of which, therefore, we have no reliable information.

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From 3^h A.M. to 4^h A.M. the sky was overcast, and clear but hazy from 4^h A.M. to 4^h 23^m A.M., when clouds began to collect, increasing in amount till 4^h 43^m A.M., after which it was continually overcast. About thirty observations were made during this time (4^h A.M. to 4^h 43^m A.M.); and it was remarked that when the sky was covered with cloud, there were frequent lightning-like flashes, evidently caused by large meteors behind the clouds.

The meteor-shower thus partially seen was evidently one of much brilliancy; the meteors generally left brilliant trains, varying in duration from one second to more than one minute: and frequent dull reports were heard, resembling very distant discharges of small ordnance; and these reports were attributed by the observers to the bursting of meteors.

On the night of the 14th the watch was resumed by Mr. Wright alone till 11^h P.M., and, with the three other observers previously named, carried on from that hour throughout the night. Until 8^h 50^m P.M. the sky remained cloudy; but at that time the clouds cleared rapidly away, and the sky was comparatively free from cloud from 9^h P.M. to 11^h P.M. During this clear period ten meteors only were observed. Clouds then intervened, and the sky continued overcast till 2^h A.M. on the 15th; it was then clear for about forty minutes (when fifteen meteors were observed), and afterwards persistently overcast during the remainder of the night.

The annexed Tables contain the observations made on these nights by the different observers, and are distinguished by their several initials; the times given are according to astronomical reckoning.

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Observations of Luminous Meteors at the Royal

Month and Day, 1868.	Greenwich Mean Solar Time.	Apparent Size of Meteor in Star-magnitudes.	Colour of Meteor.	Duration of Meteor in Seconds of Time.	Appearance and Duration of Train.	Length of Meteor's Path in Degrees.
	h m s			s		°
Nov. 13.	13 57 5	1	Blue	1·0	Train	12
	13 58 0	1	Blue	0·5	Fine	32
	13 58 22	>Jupiter	Blue	1·5	Very fine, 2°	.....
	14 4 5	1	Blue	0·5	Fine, blue	20
	14 4 40	>1	Bluish white	.....	Fine	.....
	14 6 33	2	Bluish white	0·6	Fine	10
	14 9 10	1	Bluish white	.....	Fine	30
	14 9 50	1	Blue	1·0	Fine	15
	14 11 45	1	Bluish white	.....	Blue	40
	14 12 35	1	Bluish	0·5	Blue	.....
	14 13 9	1	Blue	1·0	Fine	.....
	14 14 1	1	Blue	1·0	Fine	.....
	14 14 26	Jupiter	Blue	1·5	Fine	.....
	14 15 13	1	Blue	Momentary	.....	Stationary.
	14 15 18	Jupiter	Bright green	0·5	Red	5
	14 17 30	1	Bluish	0·5	Bright ...	10
	14 21 50	1	Bluish	0·5	Fine	16
	14 23 35	1	Blue	1·5	Fine	25
	14 24 8	1	Blue	0·5	Fine	20
	14 24 10	1	Bluish white	.....	Green.....	.....
	14 25 38	1	Bluish	0·5	Fine	16
	14 27 55	1	Bluish white	.....	Fine	.....
	14 28 26	3	Blue	0·5	None	2
	14 29 3	1	Bluish	0·5	Fine	.....
	14 30 36	1	Bluish	0·5	.....	.....
	14 32 40	Jupiter	Blue	1·5	Fine, 2° ...	25
	14 35 10	1	Bluish	0·5	.....	25
	14 35 20	1	Blue	.....	Fine	.....
	14 35 30	>1	Blue	0·8	Train	.....
	14 36 57	1	Blue	1·0	Train	10
	14 36 58	1	Blue	0·6	Train	4
	14 37 36	1	Green.....	1·0	Green.....	.....
	14 39 10	1	Bluish white	.....	.....	.....
	14 39 20	1	Bluish	0·5	.....	.....
	14 40 55	1	Bluish	.....	.....	.....
	14 42 10	Jupiter	Bluish white	.....	Fine	.....
	14 42 53	Mars	Blue	0·8	Train	8
	14 43 22	1	Blue	.....	.....	.....

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Observatory, Greenwich, November 13–14, 1868.

Path of Meteor through the Stars.	Observers.
From direction of α Ursæ Majoris passed across β Ursæ Minoris...	N.
From a little below η Ursæ Majoris towards Northern horizon.....	F.
From direction of Polaris passed across β Draconis	N.
From a point about 2° from Polaris (*i. e.* towards δ Urs. Min.) moved towards α Cephei.	F.
From direction of Cassiopeia towards North-west	N., S.
From β Arietis towards Jupiter	N., S.
From direction of Polaris towards horizon at an angle of inclination from vertical of 5°.	S.
From direction of Mars disappeared about 5° below η Ursæ Majoris	N.
From direction of α Persei to Jupiter	S.
From near η Cassiopeiæ fell almost perpendicularly towards horizon	F.
Directed from ζ Ursæ Majoris towards North horizon (inclination to left 45°).	S.
Path almost the same as that of preceding meteor	S.
From point between ϵ and ζ Ursæ Majoris passed between ι Draconis and γ Ursæ Minoris.	N.
Burst with bright blue light very near α Leonis. A nebulous light left for some time after the bursting of the meteor.	S.
From near ϵ Leonis to r Lyncis	N., S.
From near λ Ursæ Majoris to within 1° of α Ursæ Majoris	F.
From a point about 5° from Polaris towards γ Cassiopeiæ	F.
From α Geminorum passed between α and δ Orionis	N.
From near Polaris to β Draconis	F.
From Capella to α Arietis	S.
From near γ Ursæ Minoris to a point between α and η Cephei	F.
From a few degrees to west of Polaris fell with inclination of 45° to left, towards North horizon.	S.
From γ Leonis towards ρ Leonis	N.
From near ζ Cephei towards horizon. Its path produced backwards through ζ Cephei would pass about 7° below γ Ursæ Minoris.	F.
Started from a point midway between Polaris and β Cephei and disappeared near δ Cephei.	F.
Passed across κ Orionis and 5° beyond, moving from direction of Procyon.	N.
From near Pollux towards Aldebaran	F.
From direction of κ Ursæ Majoris towards γ Cassiopeiæ	S.
From μ Leonis towards ι Ursæ Majoris.....	N.
From Mars towards α Hydræ.....	N.
Passed close to α Hydræ, from direction of Mars.....	N.
From β Aurigæ towards a point a few degrees north of α Arietis ...	N., S.
Appeared about 20° above the horizon, moving with inclination of 45° towards the horizon, from direction of Rigel.	S.
From a point 10° from Procyon towards Rigel	F.
From a point 8° from Rigel towards Pleiades	F.
From ϵ Leonis passed close to γ Geminorum	F., S.
Low down in south at altitude 10°, below Sirius, moving from direction of Leo.	N.
From a point between β and γ Cassiopeiæ towards horizon at angle of 56°.	F.

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Observations of Luminous Meteors at the Royal

Month and Day, 1868.	Greenwich Mean Solar Time.	Apparent Size of Meteor in Star-magnitudes.	Colour of Meteor.	Duration of Meteor in Seconds of Time.	Appearance and Duration of Train.	Length of Meteor's Path in Degrees.
	h m s					
Nov. 13.	14 44 40	1	Blue	.....	.....	.....
	14 45 55	>Jupiter	Fine deep blue.	>2·0	Very fine, >1m.	20
	14 46 20	>Jupiter	Blue	.....	Train, 10s	.....
	14 50 43	2	Bluish white	.....	Fine	.....
	14 52 7	Jupiter	Bluish white	.....	.....	.....
	14 58 38	>1	Blue	0·8	Train	.....
	16 2 54*	>1	Blue	1·0	Train	12
	16 3 32	1	Bluish white	.....	Fine	.....
	16 6 10	1	Bluish	0·5	Fine	16
	16 7 5	Jupiter	Blue	1·3	Fine	.....
	16 7 45	Jupiter	Bluish white	.....	Fine	.....
	16 7 47	Jupiter	Bluish white	.....	.....	.....
	16 9 0	.....	.....	.....	.....	.....
	16 9 57	1	Blue	0·5	Train	.....
	16 10 57	1	Blue	0·5	Train	4
	16 11 15	1	Blue	0·5	Train	5
	16 11 17	1	Blue	.....	.....	.....
	16 11 35	Jupiter	Blue	1·0	Fine	.....
	16 11 36	>1	Bluish white	.....	Fine, 12s...	.....
	16 13 10	1	Bluish	0·5	.....	.....
	16 14 10	1·	Bluish white	.....	Fine	.....
	16 17 5	1	Bluish	.....	.....	.....
	16 18 20	Jupiter	Blue	1·5	Train, 2s...	15
	16 19 35	.....	Blue	.....	Fine, 30s...	.....
	16 20 0	1	Blue	.....	Fine	.....
	16 22 10	.....	.....	.....	.....	.....
	16 22 20	Jupiter	Bluish white	.....	Fine	.....
	16 22 22	>1	Bluish white	.....	Fine, 30s...	.....
	16 23 5	>1	Blue	1·0	Fine	10
	16 23 50	>Jupiter	Yellow	>1·0	.....	.....
	16 27 0+	Large	.....	.....	.....	.....
	16 27 40	Very large	Blue	1·0	.....	.....
	16 28 35	Jupiter	Bluish white	.....	Fine, 3s ...	.....
	16 30 5	>1	Blue	1·0	Train	.....

* November 13.—From 15h

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Observatory, Greenwich, November 13–14, 1868 (*continued*).

Path of Meteor through the Stars.	Observers.
From a point 1° east of the preceding, with path parallel	F.
From λ Ursæ Majoris passed 2° above α and β Ursæ Majoris and parallel to those stars. Very brilliant meteor, lighting up the whole sky.	N., F., S.
From ε Leonis towards horizon at an angle of 20° from horizontal.	S.
From ζ Draconis towards northern horizon at an angle of 45°. (Sky becoming cloudy.)	S.
A few degrees below place of preceding meteor, moving at inclination of 45°.	S.
Seen through thin cloud in north, falling at inclination of 45° towards west.	N.
From direction of α Leonis to a point 3° left of α Hydræ	N.
From direction of ε Leonis to between ζ and η Ursæ Majoris..	S.
From near α Leonis towards south horizon, nearly vertical	F.
From direction of ξ Ursæ Majoris passed between ε and ζ Ursæ Majoris and 5° beyond.	N., F., S.
From β Ursæ Majoris passed by β Ursæ Minoris	S.
From γ Ursæ Majoris passed a few degrees below β Ursæ Minoris	S.
Brilliant flash of light supposed to have been due to the bursting of a large meteor near horizon.	N., F.
From near β Ursæ Minoris towards horizon with inclination 45°...	F.
In S.S.E. at altitude 20°, moving towards horizon at inclination of 15° from perpendicular to left: from direction of α Leonis.	N., F.
Same position as preceding meteor. No stars near for reference ...	N., F.
Line of flight parallel to β and α Ursæ Majoris, moving towards Polaris.	F.
From direction of α Leonis, disappeared at α Hydræ	N., S.
From γ Leonis towards δ Cancri	S.
From near β Ursæ Minoris to near ψ Draconis	F.
From α Leonis to λ Ursæ Majoris	S.
Fell perpendicularly from a point 8° from γ Leonis	F.
Passed midway between 12 Can. Ven. and η Ursæ Majoris, moving from direction of ν Ursæ Majoris.	N.
Across α Ursæ Majoris towards Polaris. Centre of track α Ursæ Majoris.	F.
From Pollux towards β Tauri.....	S.
Very brilliant flash of bluish-white light in east, like lightning, probably due to a large meteor bursting.	N.
From α Ursæ Majoris towards horizon	S.
From Capella, fell nearly vertically	S.
From ζ Ursæ Majoris at angle of 45° towards north (sky cloudy).	N.
Very large yellow globe in N.E., lighting up the sky for more than 1 second (sky cloudy).	N.
Four meteors flashing behind the clouds	N.
Very brilliant meteor in S.W. seen through cloud and completely illuminating the sky. (No stars visible.)	N.
From direction of α Leonis passed between β and γ Ursæ Majoris...	S.
From direction of ε Ursæ Majoris, moved at angle of about 45° towards north; path, if produced backwards, would cut ψ Ursæ Majoris.	N.

to 16^h the sky was overcast.

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Observations of Luminous Meteors at the Royal

Month and Day, 1868.	Greenwich Mean Solar Time.	Apparent Size of Meteor in Star-magnitudes.	Colour of Meteor.	Duration of Meteor in Seconds of Time.	Appearance and Duration of Train.	Length of Meteor's Path in Degrees.
	h m s			s		
Nov. 13.	16 31 32	1	Bluish white	.....	Fine	.....
	16 34 30	>Mars	Green.....	>1·0	Vapour, 8s	Stationy
	16 34 58	>1	Blue	1·5	Train	.....
	16 38 40	1	Bluish white	.....	.....	.....
	16 39 30	.....	.....	.....	.....	.....
	16 40 25	Jupiter ×2	Yellowish ...	1·7	Fine	.....
	16 43 0*	.....	.....	....	.....	.....
Nov. 14.	8 54 51	Jupiter	Yellowish ...	1·0	Fine	12
	9 2 49	>Jupiter	Yellowish ...	1·5	Brilliant...	20
	9 45 57	1	Yellowish ...	1·0	Train	30
	9 55 5	1	Bluish white	6·0	Faint	130
	9 57 19	2	Bluish white	1·0	None	20
	10 3 26	3	Bluish white	0·5	None	8
	10 25 42	3	Bluish white	0·5	None	25
	10 45 0	1	Blue	1·0	Train	16
	10 57 42	3	Bluish white	1·0	None	10
	11 0 0†	1	Blue	0·8	Bright ...	40
	14 1 5	2	Bluish white	1·0	None	15
	14 1 25	.....	Bright red...	0·5	Yellowish	.....
	14 5 15	1	Bluish	.....	Short	8
	14 7 22	1	Bluish white	1·0	.....	Short ...
	14 9 33	>1	Bluish white	1·2	Train	12
	14 10 31	>Jupiter	Bluish white	1·5	Fine, 2s ...	30
	14 10 44	.....	Bluish	.....	.....	.....
	14 13 55	.....	Bluish	.....	.....	10
	14 14 58	1	Bluish white	0·7	Train	5
	14 15 53	Jupiter	Yellowish ...	1·5	Train	15
	14 23 14	1	Bluish white	1·0	None	20
	14 25 24	3	Bluish white	0·4	None	5
	14 25 55	1	Yellowish ...	1·0	Train	15
	14 27 57	1	Bluish white	0·7	Train	6
	14 31 55‡	1	Bluish white	1·5	None	35

* November 13.—After 16h 43m the sky remained overcast; but from that that large and brilliant meteors were still falling.

† November 14.—From 11h to 14h the sky was overcast.

‡ November 14.—The sky became overcast at 14h 40m and remained clouded

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Observatory, Greenwich, November 13–14, 1868 (*continued*).

Path of Meteor through the Stars.	Observers.
From Capella fell towards north horizon at an angle of 35°	S.
Burst at a spot midway between γ Leonis and Mars. No apparent motion.	N., S.
Passed from direction of γ Leonis (starting-point 5° above Mars) towards α Geminorum.	N.
From direction of α Leonis towards β Ursæ Majoris	S.
Very brilliant flash, sky cloudy	N.
Fell almost perpendicularly in S.S.E. from direction of α Leonis, suddenly extinguished.	N., S.
Several indistinct flashes of light in different directions, sky generally overcast.	N.
From ν Persei fell to μ Aurigæ	W.
From d Ursæ Majoris, pursued a path almost parallel to h and v Ursæ Majoris towards horizon.	W.
From direction of β Tauri passed parallel to o and ζ Persei	W.
Appeared about 3° above α Ursæ Majoris, passed about 1° above α Cephei, and disappeared near β Pegasi.	W.
From c Camelopardali towards o Ursæ Majoris	W.
From e Aurigæ, passed 3° below d Camelopardali	W.
From a point about 2° above ζ Tauri towards μ Tauri	W.
Fell nearly perpendicularly from ϵ Tauri towards horizon	N.
From m Lyncis, passed midway between ι and κ Ursæ Majoris	W.
From near Pollux towards ϵ Orionis	F.
From near f Sextantis towards α Hydræ	W.
From near Sirius towards, but below, ϵ Orionis	F.
From a point near γ Ursæ Majoris towards 12 Canum Venat.	F.
From near f Sextantis, moved towards a Hydræ	W.
From direction of ψ Ursæ Majoris, disappeared close to 12 Canum Venaticorum.	N.
From direction of ν Ursæ Majoris towards η Ursæ Majoris	N., W.
From a point below η Ursæ Majoris towards δ Draconis.....	F.
From a point above α and β Ursæ Majoris, moved towards δ Draconis.	F.
Directed from α Cancri, passed 10° to right of α Hydræ at an angle of 45°.	N.
From direction of α Hydræ towards 15 Argûs	W.
From a point a little above e Argûs towards n Argûs	W.
Directed from 40 Lyncis to β Geminorum.....	N.
From a point slightly to the right of α Cancri, disappeared a little to right of o Leonis.	W.
From direction of α Leonis, passed across f Sextantis	N.
From direction of δ Orionis towards o Ceti	W.

time till near daybreak (18^h+) flashes of light were frequently seen, showing throughout the night.

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S. CHICK, Esq., Sidmouth.

The morning of the 14th was cloudy till about 1 o'clock, when it cleared off, and we had a very fine display of meteors. I counted nearly thirty from 1 to 2 o'clock, the greater part very fine ones; all shot from Leo as an apex, and at various angles from S.W. to N.W. About the finest observed was at $1^h\ 21^m$ Greenwich mean time, shot just in line with the Pointers N.W., and left a train of golden rain, which lasted a few seconds, very much of the same character as those we observed in 1866; it began about the distance of the two Pointers toward Leo, and shot in line and almost close to the Pointers in about 2 seconds, and ended about midway between them and the Pole-Star; was about the size of Jupiter.

The maximum appeared to be from 1^h to $1^h\ 30^m$, as in 1866; very few appeared from that time to 2^h, when it began to cloud in; frequent faint flashes of lightning were observed.

W. H. WOOD, Esq., Birmingham.

13th, sky overcast all day and night.

14th, 1 A.M., sky still overcast, and misty rain. Continuous watching abandoned. About 3 A.M., sky still overcast as viewed from a window looking S.W. Observations finally discontinued. W.H. Wood remarks:—"It appears, from inquiries, that the clouds broke off in places and meteors were seen; but on account of the cloudy state of the weather they were not sufficiently numerous to attract attention here. The sky became overcast before daybreak and remained so throughout the day."

Sutton (seven miles N.N.E. from Birmingham), about $4^h\ 30^m$ A.M., the November meteoric shower seen by the writer from a window with an eastern aspect, many of the meteors were very bright and leaving trains; one was particularly beautiful; some went across Ursa Major, and some shot to the east. The number was not counted at the commencement, but less than twenty were seen. It was cloudy at times, so that only a glimpse could be obtained.

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P. SECCHI, Rome, 14 Novembre.

Les étoiles filantes de la nuit passée.—L'apparition accoutumée des étoiles filantes de la période de Novembre a eu lieu ce matin 14, avec une magnificence qui n'a pas encore eu son égale pour nous, parce que dans les années précédentes nous avons toujours été contrariés par le mauvais temps ou par la lune. Le ciel était très-serein, et le vent calme, bien qu'il soufflât un peu frais du nord. Trois observateurs ont suivi attentivement l'apparition depuis $2^h\ 30^m$ jusqu'à l'aube du jour, c'est-à-dire jusqu'à $5^h\ 45^m$. Dans la soirée et pendant les heures qui ont précédé l'apparition, on n'a vu qu'un très-petit nombre d'étoiles, et le phénomène a été saisi à son début.

Voici la distribution des étoiles observées, eu égard au temps :—

				Nombre.	
De	2 30	à	2 45	29	étoiles.
	2 45	à	3 0	50	„
	3 0	à	3 15	48	„
	3 15	à	3 30	84	„
	3 30	à	3 45	140	„
	3 45	à	4 0	148	„
	4 0	à	4 15	141	„
	4 15	à	4 30	208	„
	4 30	à	4 45	233	„
	4 45	à	5 0	264	„
	5 0	à	5 15	270	„
	5 15	à	5 30	339	„
	5 30	à	5 45	250	„
		Total		2204	„

Ce nombre de 2204 étoiles et leur marche croissante montrent que nous avons été voisins du maximum de la plus belle apparition ; cependant, le véritable maximum n'a pas pu être observé, empêchés que nous étions par la lumière du jour. Il doit s'être trouvé un peu avant ou après l'aurore, et le dernier chiffre est trop faible, parce que, à ce moment, on ne voyait plus que les plus belles, en raison de la trop grande clarté du ciel. C'est ce qui nous fait croire que le vrai maximum a eu lieu au moment du lever du soleil. Ce point pourra mieux être connu après les observations des pays plus occidentaux.

Le point de divergence de toutes les étoiles était, comme de

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coutume, l'espace de la faucille de la constellation du Lion, circonscrite par les étoiles η (éta), γ (gamma), ζ (zéta), μ (mu), λ (lambda) : mais d'une manière plus précise par l'étoile ζ (zéta). C'est en elle que se sont croisées le plus grand nombre des trajectoires des étoiles filantes, au point qu'une étoile très-brillante s'est allumée sans traînée tout près de cette étoile, laissant à sa place une petite nuée qui a couvert l'étoile pendant au moins 5 minutes. Cette étoile singulière s'est montrée à $3^h\ 50^m$ environ. Il ne peut plus y avoir de doute après cela que le point radiant est très-voisin de l'étoile ζ (zéta). Il est même certain qu'il n'en était pas éloigné de plus d'un demi-degré. La même conséquence résulte de la brièveté extrême des trajectoires des étoiles filantes qui ont été remarquées dans la partie du ciel circonvoisine.

Les étoiles irrégulières ou *sporadiques* ont été en petite quantité, c'est-à-dire quatre ou cinq au plus. Deux d'entre elles ont été aperçues dans Orion, sous Rigel à angle droit ; une autre était perpendiculaire à l'écliptique et passait par le Cancer. La plus grande partie des belles étoiles, observées entre $3^h\ 30^m$ et $4^h\ 30^m$, était dirigée parallèlement à l'écliptique, à travers le Taureau et le Bélier.

Les étoiles étaient remarquables par leur beauté et leur grandeur ; elles brillaient en très-grand nombre, étaient colorées des plus belles teintes, du vert surtout et du rouge ; un bon tiers était de la grandeur de Vénus. La plus grande partie avait un mouvement rapide et ne laissait après elle qu'une traînée de peu de durée ; cependant, quelques-unes ont laissé des traînées très-vives, et qui ont persisté pendant plusieurs minutes. Ces traînées, droites au commencement, allaient lentement en se déformant et prenant des formes bizarres, comme celle d'un 7 ou d'une serpe ; elles se dirigeaient ensuite vers le nord, en sens opposé du vent qui soufflait du *nord*. Il faut surtout signaler comme digne d'attention une étoile superbe qui s'est allumée, à $4^h\ 51^m$ environ, auprès de Régulus, laissant après elle une nuée étroite et courte en forme d'un arc, long d'un degré au plus, mais d'une grande vivacité telle qu'on a pu analyser facilement sa lumière au spectroscope. Elle a donné entièrement un spectre discontinu de raies très-brillantes dans le rouge, le jaune et le vert. Cet arc s'en allait *piano piano*, se dilatant et s'élargissant jusqu'à former un grand cercle opposé à la faucille du Lion. Il me paraît presque certain que cette apparence était celle d'une trajec-

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toire en spirale, vue selon son axe; sa lumière dura bien 10 minutes.

Beaucoup d'autres traînées furent analysées au moyen du spectroscope, et elles donnèrent les raies du sodium et du magnésium; toutefois, ces raies se montraient plus vives dans deux étoiles très-brillantes qui, par hasard, traversèrent le champ du spectromètre; même sans spectroscope, leur lumière se montrait colorée des couleurs de l'arc-en-ciel. Cette coloration fut surtout remarquable chez une étoile qui se montra, vers $4^h\ 16^m$, sous forme de très-grosse goutte d'abord rouge, puis jaune, et enfin verte et bleue. Elle restait comme suspendue, en brûlant pendant quelques secondes, dans la constellation du Corbeau, après quoi elle disparut, laissant une trace brillante et durable.

Le ciel, vers les 4 heures, déployait une clarté générale très-sensible qui s'évanouit un peu après. L'éclat de quelques étoiles était tel que l'horizon en était illuminé; quelques-unes faisaient à l'horizon l'effet d'un feu, et cet effet était dû certainement à la clarté des étoiles qui s'y enflammaient trop bas pour que nous puissions les voir.

Ayant, les années passées, traité longuement de la théorie de ces corps, nous ne nous étendrons pas sur ce point; seulement, nous dirons que leur périodicité précise est la plus belle preuve de leur nature cosmique, et que la belle théorie du Signor Schiaparelli, qui leur donne une commune origine avec les comètes, reste fortifiée d'un nouvel argument. La lumière propre de ces petits corps, discontinue dans leur spectre comme celle d'une comète, forme un autre argument physique de leur communauté d'origine.

L'heure du maximum d'intensité est un peu en retard sur le calcul, mais pas assez pour sortir des limites encore incertaines de la prévision de leur course. C'était encore bien loin de la merveilleuse pluie de feu américaine; mais, dans notre modération, elle formait déjà un phénomène d'une beauté imposante, qui remplissait l'âme d'admiration et l'élevait à de hautes pensées. Bien que nous fussions trois, nous avions peine à les compter, parce que, en général, elles venaient par groupes, et nous ne prétendons certainement pas que notre liste soit complète. La confrontation de nos observations avec celles des autres sera utile pour calculer leur course. Nous avons mis tout le soin possible à déterminer leur *traînée*, qui est le point fondamental théorique, et à fixer le nombre pour déterminer le moment du maximum.

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Nous aurions pu faire beaucoup d'observations intéressantes, mais elles auraient fait perdre de vue les deux éléments les plus essentiels.

De l'Observatoire du Collége Romain, 14 Novembre 1868.

P.S. Le vent sud, qui s'est levé vers midi, montre que le courant aérien supérieur était dirigé vers le sud, et que les *nuées* de ces météores embrasés étaient transportées par ce courant.

P. Denza, Osservatorio Del R. Collegio Carlo Alberto in Moncalieri.

Je me hâte de vous donner connaissance des observations faites dans nos contrées, lors de la chûte des météores, le 13 du mois dernier. À cause des circonstances atmosphériques peu favorables, ce phénomène, qui devait se manifester en plusieurs endroits du Piémont, ne fut observé qu'à Moncalieri et à Bra durant quelques heures après minuit. À Moncalieri, afin de mieux suivre la marche de cette apparition, nous commençâmes nos observations dès le 9, aussitôt que le temps et le clair de lune nous le permirent. Voici leurs nombres horaires.

Jour.	Nombre horaire.
9	11
10	8
11	23
12	24

Le soir du 10 au 11, le ciel fut très-nébuleux. A Bra et à Alexandrie on eut pour nombres horaires respectifs, le soir du 12, 21 et 45. Dans les nuits du 13 et 14, on commença à observer en tous les endroits dès 6 heures du soir. Les météores vus avant minuit étaient partout très-petits et ne portaient point les caractères qui distinguent ceux du période de cette nuit. Immédiatement après minuit, c'est-à-dire au moment où la constellation du Lion allait se montrer à l'horizon, on remarqua à Moncalieri et à Bra, où le ciel demeurait encore serein, une pluie de fusées provenant tous du point de l'horizon où se trouvait cette constellation et se succédant par groupes de 4, 5 et même plus à la fois.

Pour vous donner une idée de la marche de ce phénomène, je trace ci-après les nombres des étoiles qui apparurent à Moncalieri et à Bra, à toutes les heures, pour celles qui se montrèrent

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avant minuit; à toutes les demi-heures, pour celles qui furent remarquées après minuit.

	h	m		h	m		Moncalieri.		Bra.
De	6	0	à	7	0	.....	7	.....	5
	7	0	à	8	0	.....	14	.....	15
	8	0	à	9	0	.....	18	.....	26
	9	0	à	10	0	.....	24	.....	21
	10	0	à	11	0	.....	26	.....	13
	11	0	à	12	0	.....	25	.....	19
	12	0	à	12	30	.....	40	.....	35
	12	30	à	1	0	.....	46	.....	36
	1	0	à	1	30	.....	70	.....	(9)
	1	30	à	2	0	.....	94	.....	...
	2	0	à	2	30	.....	(42)	.....	...
				Total		.....	406	.....	179

A une heure le ciel était presque tout couvert à Bra; à $2^h\ 10^m$, à Moncalieri. Comme il est clair, la pluie alla croissant rapidement après minuit; elle aurait crû de plus en plus si le ciel ne s'était pas entièrement couvert. Il résulte, par les observations, faites à Mondovi, que cette apparition dura toute la nuit; le ciel était un peu voilé. Néanmoins, on vit de 4^h à $4^h\ 15^m$, 18 beaux météores traverser les quelques endroits laissés libres par les nuages; et de moment en moment on remarqua comme des traits ou des éclairs soudains qui paraissaient au-dessus d'eux.

Le Professeur Bruno put compter 15 de ces éclairs et deux météores depuis $5^h\ 30^m$ jusqu'à $5^h\ 45^m$; le brouillard vint interrompre ses observations.

Les météores vus après minuit offraient tous les apparences de ceux que l'on vit dans la pluie célèbre de 1866; leur beauté était surprenante. Ils laissaient tous jaillir une lumière vive et persistante dont on voyait les traces dans le ciel souvent pendant plusieurs secondes. Ils étaient d'une grandeur apparente supérieure à celle de Jupiter ou de Vénus et d'une couleur rougeâtre. Leur direction était uniforme, et ils provenaient presque tous de la constellation du Lion, plus précisément de la région comprise entre ζ (zéta) et γ (gamma) de cette constellation.

Nous fûmes donc les spectateurs d'un reste du nuage météorique dont la partie la plus épaisse dut s'abattre sur la terre quelques heures avant minuit; ou bien le matin du 14.

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Le soir du 14, le temps fut mauvais pour tous les points d'observation.

P.S. J'ai reçu notices de Palermo, Milan, Venise, Bergamo, Urbino ; partout le mauvais temps a empêché les observations.

G. T. KINGSTON, Esq., Magnetic Observatory, Toronto, Canada.

Nearly 3000 meteors were counted between $10^h\ 45^m$ P.M., of November 13, and 6 A.M., of November 14, Toronto time.

Two observers were constantly watching after 11 P.M., excepting between $11^h\ 50^m$ P.M. of November 13 and $0^h\ 10^m$ A.M. November 14, when only one observer was engaged in counting.

Between $0^h\ 10^m$ A.M. and 5 A.M., a third observer was frequently although not constantly assisting.

Excepting between 5 A.M. and 6 A.M. of November 14, the sky was perfectly free from clouds, and during the greater part of the time prior to 5 A.M. it was remarkably clear.

After 2 A.M. very light haze appeared occasionally. This afterwards increased, although not to any great degree, till 5 A.M.

With the exception of about 1 per cent., the courses of the meteors were from the constellation of Leo.

Many of the meteors were very large and brilliant, some exceeding Sirius in apparent magnitude, and often exhibiting a variety of colours.

Most of them were followed by trains, which often left tracks that continued visible from 2 to 4 minutes.

The following Table shows the number seen at different parts of the night, together with the state of the sky.

Toronto Astronomical Time.					Number seen during interval.		State of the Sky.
	h	m		h			
Nov. 13.	10	45	to	12	... 173	...	Very clear.
	12	0	„	13	... 329	...	Do.
	13	0	„	14	... 583	...	Do.
	14	0	„	15	... 489	...	Occasional very light haze.
	15	0	„	16	... 375	...	Do.
	16	0	„	17	... 572	...	Haze increasing.
	17	0	„	18	... 365	...	Clouds 0·4; very hazy.
	Total				2886		

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XXIV. *A Journal of Natural Appearances and Occurrences in Farming, with some occasional Remarks on the Weather, &c., made at Farningham, near Dartford, Kent, until Michaelmas* 1817, *and since at Trevereux, near Limpsfield, Surrey.* By HENRY COX, Esq.

Occasional Remarks.

1808. April 19, a heavy fall of snow for four hours; a fine productive harvest.

1809. Last week in April, very cold, wet, frosty, and unpleasant weather; May came in fine and hot.

1813. An immensely productive harvest, and a general thanksgiving for it.

1814. January 4, the deepest snow that had been known for forty years began, was some days falling, continued on the ground for five weeks; at places the drifts were 15 feet high; the frost continued twelve weeks, to March 20th.

1816. From April 12 to 15 snow remained on the ground, and the weather was severe and frosty.

September 3, a severe frost, which produced ice.

1817. The month of August very wet, succeeded in September by fine harvest weather.

1818. May 8, a deluge of rain fell, after which no more fell at or near Trevereux till September 5, being seventeen weeks and one day, during which all vegetation was completely burnt up.

1819. October 22, snow 6 inches deep.

1822. No rain from May 2 to July 5, nine weeks of very hot days.

1823. Rain little or much every day from June 29, to August 15, forty-seven days.

1824. A very wet summer, but not cold, crops of corn light, of hay heavy.

1825. Sold the produce of twelve acres of hops for 5*s.*, the crop was gathered and proved to be 24 lbs. in weight, 2 lbs. per acre only.

1826.
1827. } Two fine summers.

1828. Very heavy rain every day from July 6 to August 14.

1829. Though the 9th of April is stated as the day on which oat-sowing was finished, yet an experiment was tried by

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sowing White-gate field with black-tartar oats on the 13th of May. The weather was much against them at first; but they turned out well, and were carried on the 6th of October, the last load going into the barn white with snow.

Rain more or less every day from June 16 to September 20, being ninety-six days (except on four of them, 23rd and 24th of July, and 3rd and 4th of September); the season was not particularly cold, but the wettest in my memory.

1830. A severe frost till February 7; March was fine, dry, and warm, without a storm or a shower; April 1 was snowy till noon, whilst a swallow was seen flying about at Trevereux.

1831. On the 6th of May occurred a most severe frost: the young shoots of the ash and oak were destroyed, fruit-trees of all sorts were greatly injured, and even the meadow-grass was checked to such a degree that it never recovered; ice was nearly half an inch thick on the ponds on the common.

Note from an old book.—A severe frost occurred on the night of May 28, 1819, but inferior in its effects to the last described.

1834. A fine, dry, warm summer.

1835. April 16 and 17, a fall of snow for two days.

Although the 20th of August was noted as the time of the first and largest flight of swallows, yet it was observed that many remained longer, and they were not all gone this year until October the 20th. There are always many stragglers which remain longer than the principal flight; and some few, which appear to have lost their instinct, remain until the winter kills them by starvation and cold.

1836. September 1, swallows almost all gone.

October 29, snow fell in a frosty state of weather, and remained on the ground a week.

December 24, much snow fell at night, which, in many places being drifted, stopped the roads for several days.

1838. January 8, a very severe frost commenced, and it continued about five weeks, with some snow, the thermometer being 5° or 6° below zero: most of the evergreen shrubs were killed down to the ground.

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April 16, continued snowstorms until the 20th, and very cold.

September 10, swallows more than half gone.

1839. May 14, small snow for four hours in the morning; 15th and 16th much more, with severe frost at night.

September an extremely wet month, many floods, continued wet throughout the autumn and winter.

At harvest, this year, a single grain of wheat, planted in October 1838, in my garden, without extra cultivation, produced 2800 grains of wheat on sixty-four straws.

1840. Began with continued rain, until middle of February, then a dry spring and summer, until August 17th; the crop of hay was less than half a load per acre.

1841. Wet summer, autumn, and winter.

1842. A dry summer; the swallows began to leave the 2nd of September, most about the 15th; hay short this year.

1843. Hay abundant.

1844. August 15, many swallows gone. A long and severe winter, until March 20, 1845.

1845. Very wet summer, hay-making from July 7 to September 6.

1846. Backward spring and very dry summer.

1847. Same as 1846. Swallows almost all gone, August 22.

1848. Wet winter and spring until middle of April, then a parching drought to June 12th; wet summer and autumn after, until Christmas.

The corn of all sorts much grown and spoiled with wet.

August 1, on account of the extreme wetness of the season, many of the martins and some of the swallows disappeared.

1849. April 16 to 20, much snow and frost; the Westerham coach was buried and left all night in a snow-drift on Titsey Hill, April 19th.

A fine summer.

1850. March a dry month without a shower, but very cold and frosty.

1852. A dry winter and spring, until the 17th of May; very wet till the 4th of July, the rest of which was a scorching month, followed by a wet harvest and autumn, the like of which seldom happens.

Very few swallows this year.

1853. Rain almost daily until the 1st of November, except for

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twenty days, from the beginning of August; wheat-crop not half an average hereabout.

Water in mouse pit from November 1852 to June 15th, 1854; never known before for so much as a week at one time for thirty-seven years.

1855. Fine summer; the thermometer 11° Fahr. on the longest night, December 21.

1857. A very fine summer, hot for two months together; mild autumn, till December 31st, on which day roses, fuchsias, calceolarias, and salvias were in flower and flourishing out of doors at Trevereux.

1858. A fine, dry, hot, summer; many ponds and wells dry.

1859. The same; ditto.

1860. Wet cold spring; 6 inches of rain in June; very backward year, similar to 1816; bad haying and harvest.

August 25, many swallows gone; wet autumn and winter.

1861. Remarkable for want of bloom on fruit-trees of all sorts; the failure extended to black- and whitethorns; fine summer and autumn, to Christmas.

1862. Wet year.

1863. Wet spring, fine summer, productive harvest.

1864. Cold spring, dry summer; little hay, no turnips; harvest, except wheat, not an average.

1865. Mr. Cox saw no ice in the latter part of the year, but heard there was some on December 20; it was a very wet but very mild autumn, till January 10, 1866.

1866. The cuckoo was heard by five or six people at Trevereux, April 8th.

1867. January 2, a deep snow, thermometer at night 3½°.

May 6, thermometer 83° at noon in the shade; at night, May 16, 32°; 21, 29½°; 22, 28°. Snow 22nd and 23rd of May, in large flakes.

Thermometer, October 4, 26°, and hard frost.

Ditto, December 9, 13½°; winter early.

1868. Harvests of all sorts finished at Trevereux July 27.

Very few swallows, very many cabbage-butterflies, hot dry summer.

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Farningham.

Years.	Began to sow Oats.	Brimstone Butterfly first seen.	Bat first seen.	Finished sowing Oats.	Willow in Bloom.	Swallow first seen.	Nightingale heard.	Cuckoo heard.	Blackthorn in Bloom.	Whitethorn in Bloom.	Hops poled.	First Swarm of Bees until 1831. Then first Crocus on Lawn from 1831.	Hops tied.
1808.	Mar. 2	Mar. 4	Apr. 1	Apr. 12	...	Ap. 9	Ap 13	May 1	May 1	May 20	...	...	...
1809.	20	16	Mar. 17	27	...	20	22	4	Apr. 25	15	...	...	...
1810.	10	Feb. 28	Feb. 28	13	...	18	21	Apr. 22	30	20	...	...	...
1811.	11	Mar. 10	Mar. 20	Mar. 15	...	21	13	22	20	6	...	...	...
1812.	10	Feb. 20	Apr. 20	Apr. 11	...	21	16	May 1	27	June 4	...	...	...
1813.	20	25	Jun. 4	26	...	26	15	5	15	6	...	...	...
1814.	25	Apr. 2	Apr. 10	12	...	17	13	Apr. 20	22	1	...	...	...
1815.	4	Feb. 9	11	Mar. 18	...	13	12	May 1	6	May 15	...	...	...
1816.	11	Mar. 12	May 23	Apr. 10	...	23	19	Apr. 22	May 12	Jun. 10	...	...	...
1817.	3	Feb. 19	Mar. 21	2	...	21	May 2	May 4	Apr. 28	8	...	...	...
1818.	30	Mar. 29	Feb. 14	Mar. 31	...	16	Ap 23	Apr. 25	25	May 23	...	...	...
1819.	17	15	Mar. 24	Apr. 2	...	6	10	15	10	12	...	...	...
1820.	13	11	30	22	...	12	18	18	20	22	...	...	...
1821.	22	11	16	25	...	16	20	20	20	20	...	...	...
1822.	15	3	20	Mar. 22	Mar. 15	21	21	14	10	10	Apr. 26	May 5	June 20
1823.	29	12	24	Apr. 3	Apr. 1	16	21	21	May 1	25	May 2	7	July 5
1824.	31	17	Apr. 21	20	Mar. 30	14	24	25	3	June 5	6	...	5
1825.	24	Feb. 21	Mar. 20	7	28	14	19	23	Apr. 26	May 12	Apr. 23	4	June 18
1826.	29	25	Feb. 9	6	16	19	16	22	12	10	26	16	16
1827.	Apr. 6	Mar. 13	Mar. 20	10	23	14	15	14	18	14	29	16	29
1828.	Mar. 25	9	10	10	16	13	16	24	19	18	May 2	June 6	30
1829.	26	21	28	9	Apr. 4	14	18	23	May 7	June 3	7	10	30
1830.	Apr. 5	5	2	8	Mar. 26	1	10	15	Apr. 18	May 15	Apr. 24	2	12
1831.	11	7	Apr. 10	16	22	14	12	12	20	20	May 2	1st crocus	20
1832.	2	9	Mar. 23	11	Apr. 4	10	18	23	25	25	1	on lawn.	30
1833.	8	5	May 3	12	2	9	21	22	May 1	29	7	Feb. 18	July 2
1834.	Mar. 24	9	Apr. 7	8	Mar. 16	9	23	24	1	20	Apr. 26	Jan. 22	12
1835.	26	14	19	6	20	13	24	13	Apr. 14	25	May 2	Feb. 24	June 24
1836.	Apr. 16	19	16	19	21	19	22	18	27	June 5	4	March 2	July 1
1837.	4	Apr. 1	May 31	12	Apr. 10	25	25	23	May 15	18	6	Feb. 15	June 22
1838.	Mar. 31	Mar. 14	Mar. 20	6	3	17	23	May 3	17	6	10	March 12	16
1839.	8	3	24	12	10	20	22	Apr. 25	6	8	6	2	20
1840.	23	Apr. 2	Apr. 24	7	Mar. 26	15	21	15	Apr. 24	May 25	1	Feb. 24	1
1841.	26	Mar. 6	Mar. 7	12	25	19	19	17	22	June 4	Apr. 24	March 3	4
1842.	Apr. 8	6	Apr. 22	15	27	22	23	20	24	1	27	Feb. 26	17
1843.	Mar. 23	13	20	Mar. 29	22	9	17	19	16	May 26	29	21	July 6
1844.	Apr. 8	26	1	Apr. 13	27	15	19	21	22	26	25	March 16	June 16
1845.	1	24	Mar. 4	8	Apr. 8	18	18	23	May 5	June 8	May 12	20	July 6
1846.	Mar. 20	Apr. 30	Feb. 27	24	Mar. 12	13	14	16	Apr. 10	May 25	Apr. 25	Feb. 4	June 30
1847.	26	Mar. 15	Apr. 1	Mar. 31	26	27	21	25	May 4	June 1	May 1	20	26
1848.	May 1	4	Mar. 31	May 2	20	9	21	21	Apr. 17	1	6	18	July 10
1849.	Mar. 19	4	Jan. 31	Mar. 31	20	14	26	26	25	May 28	Apr. 21	Jan. 27	June 2
1850.	28	Feb. 18	May 2	Apr. 4	30	15	12	27	May 2	June 11	27	Feb. 19	28
1851.	Apr. 7	Apr. 15	Apr. 15	16	31	17	15	17	1	12	May 5	11	July 3
1852.	1	Mar. 20	18	7	25	18	26	20	Apr. 25	9	1	15	June 26
1853.	8	12	May 11	13	Apr. 12	14	21	19	May 16	9	4	March 3	26
1854.	Mar. 23	13	Apr. 1	11	Mar. 20	15	20	May 2	6	May 28	6	Feb. 25	23
1855.	30	Apr. 5	Feb. 27	5	Apr. 15	20	24	Apr. 28	21	June 15	5	Mar. 8	July 7
1856.	25	Feb. 16	Apr. 20	Mar. 29	Mar. 26	24	19	23	Apr. 25	May 20	Apr. 29	Feb. 23	June 19
1857	19	16	May 1	Apr. 15	20	11	20	20	28	12	28	24	20
1858.	22	Mar. 16	Mar. 23	Mar. 27	Apr. 1	15	16	16	23	30	May 1	19	19
1859.	18	5	Feb. 23	26	Mar. 20	19	25	20	6	15	Apr. 23	10	July 9
1860	Apr. 7	Apr. 4	Apr. 17	Apr. 11	Apr. 8	17	12	21	May 14	June 10	28	26	14
1861.	Mar. 9	5	Mar. 9	10	Mar. 25	22	24	20	20	4	23	26	6
1862.	Apr. 13	Mar. 24	Apr. 29	22	22	19	23	21	Apr. 29	May 19	26	5	7
1863.	Mar. 6	Feb. 27	Mar. 19	Mar. 31	20	20	19	19	16	16	25	9	June 13
1864.	19	Mar. 19	Apr. 23	Apr. 4	27	18	23	19	23	20	23	8	27
1865.	Apr. 3	31	20	7	Apr. 11	11	19	17	27	18		24	
1866.	...	26		...	4	16	17	13	26	27	No hops.	Jan. 24	No hops.
1867.	...	24	May 11	...	6	20	20	20	22	28		Feb. 13	
1868.	...	15	Apr. 4	...	Mar. 25	21	23	22	12	18		...	

Cuckoo heard.

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	Years.	Began to mow Saintfoin until 1818. Since then Meadow-grass.	Finished Haying.	Wheat in Ear.	Began Reaping.	Finished Harvest.	Began picking Hops.	Began sowing Wheat.	Swallows' Flight.	Finished sowing Wheat.	First Ice seen.	First Snow.
Farningham.	1808.	June 16	June29	June24	Aug. 5	Aug.26	...	Sep. 21	Sep. 25	Nov. 8	Nov. 6	Nov.19
	1809.	24	July 15	July 1	10	Sept. 2	...	15	20	18	Oct. 12	4
	1810.	18	6	June28	14	5	...	30	Oct. 1	20	2	Dec. 30
	1811.	3	June21	10	July24	Aug.26	...	16	10	10	12	15
	1812.	24	July 8	July 1	Aug.19	Sept. 9	...	Oct. 20	5	30	Nov.11	Nov.16
	1813.	22	4	June22	12	9	...	Sep. 28	Sep. 30	11	Oct. 20	16
	1814.	28	13	July 4	21	7	...	23	28	7	5	Dec. 25
	1815.	10	June24	June22	9	Aug.26	...	Oct. 9	Oct. 1	4	20	10
	1816.	25	July 31	July 14	29	Oct. 12	...	2	Sep. 14	19	25	Nov. 8
	1817.	21	14	June24	15	Sep. 10	...	8	Oct. 13	22	20	Dec. 12
	1818.	18	June30	8	July27	Aug.12	Aug.31	Sep. 29	15	Oct. 31	Nov.20	None.
	1819.	19	July 24	19	31	25	Sept. 8	Oct. 1	6	Nov.19	Oct. 21	Feb.2. Oct.22
	1820.	July 3	31	25	Aug. 9	Sep. 13	13	2	1	6	Nov.20	Nov. 13
	1821.	10	Aug.13	July 9	21	19	10	Sep. 20	Sep. 26	8	30	None.
	1822.	June 16	July 10	June10	July 16	Aug. 8	2	27	28	14	17	Dec. 25
	1823.	July 7	Aug. 15	19	Aug.16	Sep. 20	26	Oct. 6	Oct. 2	Oct. 31	3	18
	1824.	5	10	26	16	30	see] 14	18	Sep. 27	Nov. 1	Oct. 12	None.
	1825.	June 28	July 18	20	July22	Aug.21	remarks.	15	27	Oct. 26	26	Mar10. Dec.27
	1826.	26	18	21	23	15	Sept. 4	4	20	3	Nov. 7	Dec. 6
	1827.	25	21	24	Aug. 3	28	14	8	10	1	1	Nov. 21
	1828.	29	Aug.16	20	July31	26	15	8	5	28	8	None.
	1829.	July 15	Sept. 1	24	Aug. 4	Oct. 6	21	12	1	31	Oct. 7	Jan. 7. Oct. 6
	1830.	5	Aug. 2	26	9	Sept. 1	13	6	17	27	27	Dec.16
	1831.	2	July27	16	July29	Aug.22	Aug.29	15	20	Nov. 3	Nov.10	None.
	1832.	2	28	21	Aug. 4	Sept. 4	Sep. 10	16	13	Oct. 22	Dec.16	Dec. 31
	1833.	June 29	29	18	July31	Aug.21	16	9	9	30	Nov.26	None.
	1834.	18	30	16	23	12	15	1	1	Nov.21	Oct. 23	Nov.21
	1835.	July 1	25	15	27	15	4	14	Aug.20	Oct. 19	2	11
	1836.	4	27	20	Aug.10	Sept. 5	12	14	Sep. 10	24	29	Oct. 29
	1837.	5	24	July 2	14	4	11	9	20	Nov. 3	Nov. 7	Nov.25
	1838.	13	Aug.10	1	13	1	19	8	21	Oct. 26	11	None.
	1839.	8	3	June25	7	14	16	8	6	Nov. 8	27	Jan. 6
	1840.	1	July30	20	3	1	14	7	22	Oct. 28	20	Feb.19. Dec.14
	1841.	3	Aug.27	26	12	10	13	20	24	Nov. 6	Oct. 22	Nov.16
	1842.	4	July23	15	1	Aug.22	Aug.31	4	18	Oct. 8	20	5
	1843.	3	Aug.21	24	11	Sept. 6	Sep. 18	14	Oct. 4	19	19	None.
	1844.	27	20	20	July29	Aug.29	16	10	1	23	9	Jan. 1
	1845.	7	Sept. 6	July 6	Aug.21	Sep. 20	29	14	Sept. 8	18	Nov. 3	29. Dec.22
	1846.	1	Aug. 9	June23	July23	Aug.15	7	26	20	Nov. 2	9	Dec. 11
	1847.	3	July26	26	Aug. 2	28	10	8	Aug.25	Oct. 20	18	None.
	1848.	3	Sept. 6	26	July31	Sep. 15	Oct. 9	Sep. 20	Sept. 1	Nov. 4	21	Jan.18
	1849.	June 9	July13	28	Aug.10	8	Sep. 10	Oct. 9	Aug.30	Oct. 29	26	5. Dec.21
	1850.	24	Aug. 9	30	7	9	11	7	Sep. 10	17	15	None.
	1851.	July 3	2	30	11	1	17	15	22	27	5	None.
	1852.	6	July31	25	3	11	13	18	5	22	20	None.
	1853.	6	Aug. 9	July 6	18	17	26	Nov. 1	21	Nov.15	17	Feb.5. Dec.15
	1854.	19	12	8	15	5	25	Oct. 12	20	2	Oct. 27	None.
	1855.	4	15	10	13	Aug.30	10	12	8	Oct. 24	Nov.16	Jan.17.
	1856.	June 27	2	June30	13	27	4	11	20	24	6	9. Nov.26
	1857.	18	July 15	15	July24	16	2	10	28	29	Dec. 5	None.
	1858.	15	26	16	28	23	6	15	19	Nov. 3	Nov.10	Feb.2.
	1859.	22	18	14	26	12	5	24	10	14	Oct. 22	Jan.31. Oct.24
	1860.	July 9	Sept. 1	July 12	Sept. 3	Oct. 5	Oct. 1	22	Oct. 2	Oct. 27	12	Nov.18
	1861.	1	July30	June16	Aug.10	Aug.27	Sep. 12	4	10	15	Nov. 4	2
	1862.	June 20	31	26	9	Sep. 13	15	11	Sep. 18	Nov.15	11	Feb. 7
	1863.	29	25	20	4	3	18	15	12	Oct. 29	10	None.
	1864.	27	12	20	5	Aug.19	Aug.31	11	Aug.30	25	10	Jan.2. Dec.17
	1865.	19	20	17	July24	30	no hops.	...	Sep. 20	...	see note.	13
	1866.	24	2	20	Farm let from Michaelmas				Aug.29	...	Nov.20	11
	1867.	26	5	22	1865.				Sep. 10	...	3	1. Dec.2
	1868.	15	June17	10	.....				...	...	...	.....
Treverux.												

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OF
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SESSION 1868–69,

25 GREAT GEORGE STREET, WESTMINSTER, S.W., AT 7 P.M.

1868. November	18	1869. March.....	17
1869. January	20	„ April	21
„ February.....	17	„ June	16

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OF

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EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

1869, JANUARY 20.

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THE METEOROLOGICAL SOCIETY.

EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

Vol. IV. 1869, JANUARY 20. [No. 40.

JAMES GLAISHER, Esq., F.R.S. &c., President, in the Chair.

Percy Bicknell, Esq., Foxgrove, Beckenham, Kent, S.E., was balloted for and duly elected a Fellow of the Society.

The Names of five Candidates for admission into the Society were read.

XXV. *The Weather in connexion with the Crop of Hops of the Year* 1868. By F. W. Doggett, Esq., F.M.S.

It might naturally be expected that the unusually fine weather of the past spring and summer would have produced one of the most abundant as well as the best crops of hops ever known; and in the early spring the vigorous growth of the plant fully justified even those who were most sanguine; indeed such was almost universally the expectation of those persons most conversant with the growth of hops.

But this was not to be.

It may be remembered that in the year 1854 I prepared a paper upon this subject, in which it was shown that the hop-plant was never fatally blighted with *Aphis* unless there had been an excess

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of rain in the months of July, August, and September of the previous year. This has been fully borne out by later observations.

On the 7th of May I wrote in my journal that I expected a blight this year in hops.

The favourable accounts continued until about the 21st of May, when an attack of *Aphis*-fly was observed in some districts of Kent and Sussex, which, however, did not remain long. It was the opinion of many people that they were either eaten or driven away by the lady-bird, which appeared in immense numbers.

On the 30th of June I observed on a hop-plant in my garden at Dalston, a new description of *Aphis*-fly—at least, one that I had never seen in the plantations before; it was rather larger than that hitherto known as the hopfly, and the colour of its body somewhat darker.

Upon careful examination I found, on the underside of many of the large leaves, a spider's-web, spun in patches; this was not constructed with lines radiating from the centre, but as if the insect had moved about at random, thus forming a web like that found in the hedges in autumn. The spider is small, almost invisible without the aid of a glass.

The fly produces its young as lice, which differ in size and colour, as well as in activity, from the ordinary louse, being smaller, with spots on either side, and travel over the leaf very fast.

I observed also a number of small eggs, perfectly round, white, black, and red, attached to the underside of the leaves; these I believe to have been spider's eggs, because I saw a spider very busy with a number of them enveloped in a web.

I was much amused whilst in a hop-garden at Erith in observing a spider running about evidently in search of its food. I saw it seize a louse in its mouth, shake it, and try to squeeze it under one of the ribs of the leaf, apparently to keep it quiet whilst devouring it.

Upon going into various parts of Kent during the succeeding few days, I found exactly the same condition of things; and there were very few hop-districts in England where the hop-gardens were entirely clean.

In some places the lice did not increase to any great extent, whilst in others, particularly from Tunbridge to the north of Kent, round Maidstone, and in some parts of east Kent, near Canterbury, as well as in other districts, occasionally the increase was most rapid.

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In the course of about three weeks the leaves of the plant began to show the effects of the blight, changed colour from green to brown, and eventually dropped off, the blossom withering at the same time.

In some instances a few days would suffice. I was in one garden near Maidstone on the 6th of August where the leaves and blossoms were dead. The labourers told me that a week previously a large crop was expected.

Rain did not appear to be in any way beneficial. On the contrary, the remarks constantly heard two or three days after the rain, were, "The hops are much worse." The ground being so hot, most likely the rain was evaporated soon after it fell.

I believe that the small rootlets or fibres in searching near the surface for moisture were parched with the heat, thus assisting the enemy in his work of destruction.

Besides this new and peculiar blight, the plant has suffered severely from mould; in many gardens promising large crops the flowers completely withered away.

I may here mention that about four years ago I thought a great deal as to the weather suitable to the growth of this fungus, and after much consideration I came to the conclusion that the absence of thunder and lightning about the time that the flower is being perfected has great influence; upon referring to those years in which the disease had been very fatal, such I found to be the case, and the reverse when the crop was large and healthy.

On the 13th of August I started on a journey to visit the principal hop-growing districts on the Continent, and throughout the whole of my route in Belgium, Bavaria, Wurtemburg, Alsace, &c. I found precisely the same blight on the hops, only differing in degree in the several countries.

None of the peasant farmers seemed to know what it was that produced the state the plant was in, until I showed the insects to them through my glass, but called it always "copper-burnt."

In Hersbrook district, in Bavaria, I observed that the hills facing the north were quite blighted, whilst those sloping to the south were comparatively free. I account for this by supposing that northerly and easterly winds are not so suitable to vegetation as southerly and westerly.

Our news from America was also most favourable up to the 6th of September; but on that night the weather changed to "hot, foggy, showery, reeking weather; and splendid yards perished in a

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night from lice and mould." I am induced to think that the diseases were present before that time, but had not been observed.

It is most interesting thus to trace the same diseases in the hop-plant, extending over so large and wide a space at the same time, and to find that one of those diseases was never known before to attack and destroy the plant either in England or on the Continent.

XXVI. *On Reducing the Barometric Readings to the Sea-level.* By the Rev. W. PREVITÉ, M.A., F.M.S., Little Wratting, Suffolk.

THE object of this short paper is to endeavour to apply the corrections of the barometer for altitude more approximately to their true values than by the methods commonly used.

The problem of finding the difference in height between two stations is fully investigated by Duhamel (Cours de Mécanique, vol. ii. art. 169 *seq.*). For low heights, in the neighbourhood of latitude 45°, he establishes the formula—

$$z = 18393(1+\alpha\theta)\log\frac{h_0}{h}, \text{ in metres.} \quad \ldots\ldots \quad (1)$$

where z = height above the sea-level; $h_0 h$ the readings of the barometer (reduced to 0° C.) at the sea-level and height z respectively:

α = coefficient of expansion for moist air.

= ·004 per 1° C.

θ = mean temperature, $= \frac{t_0+t}{2}$,

t_0 t being respective temperatures at sea-level, and height z.

Reduced to English measures (1) becomes

$$(2)\ldots\ldots \quad z = 60345{\cdot}1\left\{1+{\cdot}00222\left(\frac{T_0+T}{2}-32\right)\right\}\log\frac{h_0}{h}; \text{ feet.}$$

T_0 T representing degrees Fahr.; h_0 h inches.

Now, putting

$$h_0 = 30, \quad h = 29{\cdot}9, \quad \frac{T_0+T}{2} = 32°,$$

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we get

$$z = 87{\cdot}51 \text{ ft.}, \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

the number of feet in a column of air at 32° Fahr., supported by 0·1 in mercury, the pressure at the base being 30 inches.

This result properly holds for latitude 45° only, the factor $1+{\cdot}002588\cos 2\lambda$ (where λ=latitude of the place), due to the variation in the accelerating effect of gravity, being neglected in (1).

If for λ we put 51°, latitude of Greenwich, we get for (3) 87·36 ft.; but a slight increase will be made to this by the aqueous vapour in the air, and it will be found that 87·51 may be taken as the height of a column of moist air supported by 0·1 in. merc., in the latitude of Greenwich, pressure at the sea-level being 30 ins. (The method of investigating the decrease of density due to the presence of vapour is given in Miller's 'Hydrostatics,' arts. 41–48)*.

The height supported by 0·1 in. merc. at any temperature $t°$ F., will be equal to $87{\cdot}51\ (1+{\cdot}00222\overline{t-32})$ ft., as given in Mr. Glaisher's Table. Let this $=\frac{H}{10}$; then if

a= altitude of a place above sea-level, in feet,

x= difference of barometer from 30 ins.,

$$x=\frac{a}{H} \text{ ins.} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

If the barometer at sea-level be different from 30 ins., since the correction will vary directly as the height of the barometer, we have, putting h= height at altitude a, $h+x$= that at sea-level,

$$x=\frac{a}{H}\cdot\frac{h+x}{30}, \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

where

$$H=875{\cdot}1\ (1+{\cdot}00222\overline{t-32})\text{ ft.}$$

"[t= (observed temperature at altitude a) $+\frac{a}{600}$, strictly, assuming that temperature falls 1° Fahr. for every 300 feet of ascent.—(Herschel's Meteorology, art. 22.)]."

To find x from (5), for a first approximation, omit x on right hand.

Then we have $x=\frac{a}{H}\cdot\frac{h}{30}$, which, inserted for x on right hand,

* Jamin (Cours de Physique, vol. i.) obtains 18405 for coefficient in (1), or 60382·1 in (2), from which (3) becomes 87·56, and in latitude of Greenwich 87·51, as above taken.

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gives

$$x=\frac{a}{H}\cdot\frac{h}{30}+\frac{a^2h}{H^2 30^2}. \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

To adapt this to a Table calculated for 30 ins., put

$$\frac{a}{H}=l, \quad \frac{a}{H\times 30}=\delta,$$

then

$$x=\delta h+\delta^2 h,$$
$$=l+\delta(h-30)+\delta^2 h, \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

and the reading of the barometer at sea-level is

$$h+x=h+l+\delta\overline{h-30}+\delta^2 h. \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

A Table may be formed for l from formula

$$l=\frac{\text{altitude of place}}{875{\cdot}1\{1+{\cdot}00222(t-32)\}},$$

by putting

$$t=32°, \quad t=40°, \quad 45°, \quad 50°, \text{ \&c., and } \delta=\frac{l}{30}.$$

Ex. Let altitude =300 ft.: then at 32°, $l={\cdot}343$; at 40°, $l={\cdot}337$.

ft.	32°.	40°.	45°.	50°.	55°.	60°.	&c.
300	·343	·337	·338	·330	·326	·323	&c.

Let, for instance, the reading of the barometer reduced to 32° be 29·852, temperature of air 40°; then $l={\cdot}337$, $\delta={\cdot}0112$, $\delta^2={\cdot}00012$. And

$$\begin{aligned} h &= 29{\cdot}852 \\ l &= +{\cdot}337 \\ \delta(h-30) &= -{\cdot}0017 \\ \delta^2 h &= +{\cdot}0035 \\ \overline{h+x} &= \underline{30{\cdot}190} \end{aligned}$$

which is the reading reduced to sea-level and 32° Fahr.

The form (7) shows the approximations to correction given in FitzRoy's Manual, and Drew (Meteorology, p. 141). Thus, by FitzRoy, reading is $h+l=30{\cdot}189$; by Drew, $h+l+\delta(h-30)=h+\delta h=30{\cdot}187$. Hence we see the importance of the third term in (7). At the same time, for low heights (as the Cambridge Observatory, 88 feet), it would not afford the third decimal in general.

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This might be made shorter in practice by writing

$$x = \delta h + \delta^2 h \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

and performing the calculations thus indicated.

Thus

$$h + x = h + \delta h + \delta^2 h,$$

in the example, where

$$\delta = \frac{\cdot 337}{30} = \cdot 0112.$$

29·852	.....	h
·0112	.....	δ
59704		
328372		
·3343424	.....	δh
·0112		
·0037446	.....	$\delta^2 h$
·33434	.....	$+\delta h$ } adding.
29·852	.....	$+h$ }
30·190	.....	$h+x$.

This method is shorter than the former, but care must be taken to take δ to 4 or 5 places of decimals.

The result in this case agrees with that obtained below by the original formula (2).

As any formula requires a good many figures, the correction might perhaps as easily be derived from the form (2) by using a Table of logarithms. Thus, dividing and transposing,

$$\log h_0 = \log h + x \times \cdot 00001657(1 + \cdot 00222\overline{t - 32^\circ});$$

and for the above example,

$$\log h_0 = \log 29\cdot 852 + 300 \times \cdot 00001657(1 + \cdot 00222 \times 8).$$

The second term on the right hand may be found from a Table prepared beforehand for the particular altitude.

$$\therefore \log h_0 = 1\cdot 4749734$$
$$+ \cdot 0048828$$
$$1\cdot 4798562 = \log 30\cdot 1895,$$

or $h_0 = 30\cdot 190$, as before.

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XXVII. *On the Method adopted for Dividing Alcohol Minimum-Thermometers.* By F. PASTORELLI, Esq., F.M.S.

Mr. GLAISHER, in his Annual Report, kindly called attention to minimum alcohol thermometers constructed by me as being extremely accurate from the freezing-point to that of zero.

It was then explained that this degree of accuracy was obtained by a system of fractional allowances.

Believing that it might prove acceptable, I am induced to give a detailed description of the method by which I obtained these results.

The errors of alcohol thermometers arise principally from two causes,—

First, from the irregularity of the bore of the tube.

Secondly, from the unequal expansion of the spirit.

I select from a number of thermometer-tubes those which I judge to be the most uniform in the bore; these are cut into the required lengths. Into one of these tubes I introduce a small quantity of mercury filling about 1 in. of the tube, but whose real length may be expressed by (l). The mercury is then moved forward in the tube inch by inch, and careful readings taken of its length; from these data I calculate the mean length (l) of the mercurial column. Assuming this to be the true length, I find that part of the tube where the readings coincide with the calculated mean (l); this part of the tube I take as being uniform in its bore; I then blow and fill the tube in the usual way. I next determine the exact number of degrees (n) in the length (l); in that part of the tube where the bore is uniform in this length, the only correction needed is for the contractility of the spirit; if the coefficient of expansion of the spirit for 1° be (m), we find the true length (d) of the first degree in this length to be

$$d = \left\{ \frac{l}{n} - \frac{n-1}{2} m \right\}.$$

The value of the first degree being ascertained, each following degree is found by adding to the preceding one the coefficient of expansion (m). In those parts of the tube where the bore is not uniform, we have, in addition, to add or subtract from each degree its correction for the want of uniformity; supposing the length of the mercurial column was in one part of the tube $l+a$, each degree for this length would obtain its corresponding correction

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by adding $\frac{a}{n}$ to each degree, where n expresses the number of degrees for this length $(l+a)$.

The necessary correction being thus obtained, both errors are eliminated in the subsequent process of dividing by the ordinary dividing-engine; assuming that the differences be correctly taken and the dividing carefully performed, the result will be satisfactory.

As some differences of opinion exist as to the probable errors in alcohol thermometers, I have found, by examination, errors in otherwise carefully constructed instruments to the extent of 1° to 2° at their lower points. In alcohol thermometers I have, of late, made corrections varying from 1° to 2°. In ordinary alcohol thermometers these two errors usually exist varying from 1° to 2° at their zero.

In conclusion, I beg to thank Mr. Glaisher for having called my attention to the defect in minimum thermometers, and I do think all are indebted to that gentleman for pointing out such errors, more particularly the manufacturers, as it will, no doubt, tend to ensure the manufacture of correct and reliable minimum thermometers, equal for all practical purposes to that of any mercurial thermometers.

XXVIII. *On the Storm of the 8th and 9th of September, 1867, at Sombrero.* By R. H. TWIGG, Esq., C.E., F.M.S.

ABOUT 2 P.M. on the 8th, indications were observed of a storm from N.N.E. The barometer had been lower than usual for a few days. The wind rose and the barometer went down till 8 P.M.; from that time till 10 P.M. the wind increased to a gale and veered round to E.

From 10 P.M. till 4 A.M., on the 9th it continued: about 2 A.M. the greatest depression of the barometer was observed, being $\frac{1}{10}$ inch. At 4 A.M. the wind was S.E., and by 10 A.M. its force had decreased down to a strong trade, and at 11½ A.M. a heavy rain commenced. During the gale the spray formed a beautiful fringe along the eastern side of the island, rising at least 60 feet (some say 100 feet) into the air, and the wind drove it across the island, moving heavy pieces of iron at the lighthouse.

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Storm on the 8th of October.—This storm blew steadily from S. with great force.

Hurricane of the 29th of October.—For some days previous to the 29th the weather was sultry and hot and seemed to foretell something. On the morning of that day, about 1 o'clock, the wind began to blow in puffs from N.E. At about 5.30 A.M. there was no doubt that a hurricane had commenced, and such preparations as could were made at the lighthouse during the next three-quarters of an hour, when it became impossible to remain longer outside. The barometer was observed at about 8 A.M., by striking a match, the only light that could be had, and was found standing at 28·65 inches. No other observation could be made until it was safe to open the doors and admit light during a lull about 9 o'clock, when it read 29·95 inches. The wind at 8 o'clock was N., blowing clouds of spray before it; it veered round after that to N.E., and after the lull it blew from E., and attained its greatest force between that time and 11 o'clock, when it abated sufficiently to allow a few persons to venture out. It gradually from 11 o'clock to about 1 o'clock veered further round to S.E., still blowing a gale, and then died away, settling into the regular easterly trade. A calculation based on the fractures of some iron bars proves that the force of the wind must have been about 100 lbs. per square foot.

The following facts bear evidence as to the actual force of the wind and drifting spray. The anemometer had three of its cups blown away and the fourth loosened. One-half of my door, 18 inches wide, was opened before the lull; two men held me while I tried to shut it, but I failed; another man tried and succeeded, but it took three others to prevent him from being blown away while he had his head and shoulders out of the door. Pieces of rock were severed from the solid by the force of the wind and spray, leaving a broken section with a surface of about 1 square yard.

A stone, weighing by measurement 25 cwt., was lifted from the cliff 36 feet high and deposited a considerable distance inland.

The sea could not rise (*i. e.* a heavy swell) owing to the wind shifting its direction so quickly; but the water was blown out of it and fell on the island, making a stream flowing from east to west.

The lighthouse, at the time the storm occurred, was erected to the height of 70 feet from the ground and 106 feet from the level of the sea. It was only partially rivetted to the height of 54 feet, the

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rest being merely temporarily bolted together. It is fastened to the rock by thirty-six 2-inch iron bolts let into holes, the void spaces of the holes being filled in with Portland cement. No evidence of even shaking of the structure could be perceived in the form of cracks in the cement or otherwise, and the only damage done was to the unfinished parapets of the dwellings, part of the top rail of some of them having been broken. The main structure remained as perfect as before the storm; one or two only of the stay bars, however, were bent by planks falling from the staging above.

Earthquake of the 19th of November.—An earthquake occurred at 5 minutes after 8 on the afternoon of the 19th of November without doing any damage.

Earthquake of the 29th of December.—A severe earthquake occurred at 6 minutes after 9 on the evening of the 29th of December. Several lesser shocks occurred during the succeeding twenty-four hours; both earthquakes appeared to travel in an east and west direction.

Rainfall.—Showers of rain occur frequently, and heavy falls about twice in the year. The rain-gauge was injured by the sea in the storm of the 8th and 9th of September, and observations were discontinued. With hardly an exception, the showers were accompanied by heavy squalls of wind. A shower approaching the island generally divides into two parts, one going to the north, the other the south, so that at the centre of the island only a few drops may fall, while at each of the ends, or beyond them, there is heavy rain. The erection of the lighthouse, which is a good conductor of electricity, to the height of about 160 feet above the sea, has not altered this curious phenomenon.

The most probable explanation is that the radiant heat of the island evaporates the drops as they fall. A similar phenomenon occurs at the island of St. Martin, about forty miles from Sombrero, where a salt pond is surrounded by land that is clothed with vegetation; the solar rays, being reflected back into the air, evaporate the drops, and so cause less rain to fall on the pond than on the adjacent land. This converse case was mentioned to the author by the King's Attorney for the island, with the above explanation, as given by an engineer whose name the author does not recollect.

Dew.—It is very rarely any dew is deposited during night; and when it is, it is only to a very slight extent. This may be ac-

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counted for in the same manner as the lessening of the rainfall on the island, compared with that on the adjacent sea.

Tides and Currents.—It is very much to be regretted that neither time nor opportunity permitted a register of these phenomena; for I have little doubt that with one year's observation of the rise and fall of the tide, and the direction, rate, and temperature of the currents, their direction at any time could be foretold. This would be a boon to vessels passing through this channel into the Caribbean Sea. The current runs past the island at the rate of from two to three knots per hour, estimated generally by the masters of vessels visiting the island. Its direction changes with great apparent irregularity. It flows, as a rule, from points between N.E. and S.E.; but I have observed it flowing from W. to E. more than once. I believe its direction to be, to a great extent, independent of that of the wind. The range of tide is about 16 inches, and there appears to be little semidiurnal action in it.

Meteorological Observations taken at Sombrero during September and October 1867.

1867. Day.	Reading of Barometer.		Reading of Thermometer.			Wind. Miles per Day.	Remarks.
	Height.	Temp.	Dry-bulb.	Max.	Min.		
	ins.	°	°	°	°		
Sep. 13	30·226	84·0	82·3	.....	.....	.....	
14	30·178	83·0	88·7	91·8	78·5	318	
15	30·262	84·0	83·8	87·7	80·0	460	Level of barometer 36 feet above mean sea-level, No. 166, B.T.
16	30·174	83·5	83·7	89·5	79·8	460	
17	30·128	82·5	83·0	91·2	79·1	305	
18	30·120	82·5	81·8	93·0	78·0	175	All thermometers on wooden building, 4 feet from ground, under verandah, in shade.
19	30·184	83·0	83·2	90·1	78·0	110	
20	30·230	.....	83·3	.....	78·7	175	
21	30·200	84·0	83·2	89·5	77·8	235	
22	30·136	83·2	83·8	90·0	78·5	260	Dry-bulb, No. 155, Casella.
23	30·150	83·0	84·3	94·3	79·5	90	Max. No. 94, Casella.
24	30·168	83·2	83·5	92·5	84·0	165	Min. No. 104, Casella.
25	30·200	82·0	81·5	93·7	78·5	185	Speed of wind taken by Casella's anemometer.
26	30·210	84·0	84·2	93·8	80·0	210	
27	30·168	84·5	84·5	94·8	84·5	260	All observations at 9 A.M.
28	30·210	84·0	83·8	92·8	80·0	355	
29	30·212	83·0	83·7	93·0	.....	410	
30	30·256	83·5	84·5	91·8	.....	160	

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Meteorological Observations taken at Sombrero during September and October 1867 (*continued*).

1867. Day.	Reading of Barometer.		Reading of Thermometer.			Wind. Miles per Day.	Remarks.
	Height.	Temp.	Dry-bulb.	Max.	Min.		
	ins.	°	°	°	°		
Oct. 1	30·250	84·0	85·2	98·7	79·5	55	Very calm.
2	30·170	82·0	81·0	98·7	79·8	11	„ „ wind S.
3	30·100	81·0	79·9	83·0	75·7	61	„ „ „ S.W. & S.
4	30·114	82·2	82·6	83·6	76·2		
5	30·150	79·5	79·0	91·8	72·5	173	Very hard rain.
6	30·134	82·0	83·2	93·5	78·5	200	
7	30·100	84·0	88·4	91·3	78·5	660	Very high wind during night, barometer down to 29·900 inches.
8	30·012	83·0	82·6	91·5	79·0	935* or 430	Strong wind blowing.
9	30·048	80·5	79·7	86·8	72·0	985† or 480	Storm at night.
10	.....	.....	82·4	86·8	78·8	375	
11	30·150	82·0	82·1	91·8	79·0	270	
18	30·070	83·0	82·3				
19	30·106	82·0	81·0	92·0	77·0	280	
20	30·158	82·2	81·2	92·0	77·2	355	
21	30·140	83·0	82·8	93·0	79·0	175	
22	.....	.....	.....	95·8	78·7	350	
23	30·064	83·2	83·0				
24	30·070	83·25	82·8	93·2	78·0	55	
25	.....	.....	82·3	98·8	76·7	5	
26	30·128	83·5	83·3	99·7	76·6	0	Heavy ground swell from N.W.
27	30·184	83·75	83·5	99·5	76·8	50	
28	30·196	85·0	84·2	99·5	76·9	145	
29	.....	.....	.....	.....	.....	.....	Hurricane observations discontinued.

* The higher number is probably the most correct, as the index is almost certain to have gone round once =505 miles more than 430.

† For the same reason as above, the higher number is more likely to be correct; but it might be 505 above that again. It was impossible to make an observation during the storm owing to the sea.

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CORRESPONDENCE, &c.

To the Editor of the Meteorological Proceedings.

Branch Hill Lodge, Hampstead, N.W.,
November 20, 1868.

DEAR SIR,—Your notes on the weather of the last quarter have just come to hand, and I see only four displays of *aurora borealis* are noted (on the 5th, 15th, 18th, and 20th of September). I, therefore, send a line to say that a fine aurora was visible at *Whitby* on the *20th of August*. A hasty note in my journal says, "Aurora extensive, bright, with the arch and streamers strongly marked; but without much colour." I have not noted the time; but as far as I remember, it appeared about 9.30 (whether by the clearing off of cloud or not I cannot say), and lasted about an hour, after which it gradually faded and was lost behind cloud.

I see you have no observer very near Whitby, so it was probably the local state of the weather that allowed the aurora to be visible there and not at other northern stations. I thought you might like to know the circumstance in order to render your record more complete.

I am, dear Sir,
Yours sincerely,
B. WOODD SMITH, F.M.S.

Glasgow Observatory.

Maximum Temperature (in shade) of the Ten Hottest Days in the Nine Years 1860–68.

1860.		1861.		1862.	
Date.	Maximum Temp.	Date.	Maximum Temp.	Date.	Maximum Temp.
	°		°		°
July 4	71·8	June 13	73·4	June 2	68·2
5	72·0	14	75·5	July 13	66·7
6	73·9	15	73·5	14	66·7
7	80·2	18	71·1	31	68·8
8	77·6	19	72·7	August 2 ...	67·9
9	76·0	20	78·5	9 ...	68·1
11	69·9	21	73·7	20 ...	66·9
12	71·4	26	70·5	29 ...	67·5
13	74·2	27	71·8	Sept. 19	68·7
September 6...	70·0	July 20	70·6	20	69·7

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Maximum Temperature (in shade) of the Ten Hottest Days in the Nine Years 1860–68 (*continued*).

1863.		1864.		1865.	
Date.	Maximum Temp.	Date.	Maximum Temp.	Date.	Maximum Temp.
	°		°		°
July 6	70·5	July 7	71·0	June 14	75·2
9	71·6	13	73·0	15	73·8
10	67·7	14	70·2	17	81·2
11	70·6	18	73·0	18	77·6
12	69·5	August 12 ...	71·6	19	74·3
14	67·0	13 ...	72·0	20	75·2
31	70·6	14 ...	76·0	22	76·4
August 1 ...	71·7	15 ...	73·0	July 4	73·7
2 ...	71·9	16 ...	71·2	23	75·4
3 ...	70·2	30 ...	70·2	24	77·4
1866.		**1867.**		**1868.**	
	°		°		°
June 24	77·9	June 11	74·4	June 19	79·6
25	77·0	26	72·8	30	78·0
26	77·5	July 9	77·8	July 2	80·2
27	78·6	10	76·8	14	80·0
July 12	81·2	11	76·6	15	85·6
13	77·6	12	75·6	28	81·0
18	75·8	August 11 ...	71·0	August 2 ...	85·9
20	75·7	12 ...	75·9	3 ...	84·1
22	75·9	13 ...	71·2	4 ...	87·2
Sept. 15	76·7	14 ...	72·6	5 ...	82·8

The following is a statement of the mean value of the maximum temperature corresponding to each of the foregoing groups of days:—

Year.	Mean value of Maximum Temperature.
	°
1860	73·7
1861	73·1
1862	67·9
1863	70·1
1864	72·1
1865	76·0
1866	77·4
1867	74·3
1868	82·4

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The ninety hot days included in the nine groups for 1860–68 may be thus classified:—

	days.
June	25
July	40
August	21
September	4

—R. GRANT.

Hygrometrical Observations on Snowdon, October 14, 1868 (a fine bright day). By the Rev. M. SNOW.

Height.	Hour.	Dry.	Wet.	Remarks.
ft.	h m	°	°	
920	*	54·0	49·2	At Penygwryd Inn.
1300	10 0 A.M.	48·5	45·5	Near head of Llanberis Pass.
1400	10 20	47·0	45·5	Along margin of Llyn Llydaw.
	10 30	46·2	44·0	
	10 35	47·0	44·5	
	10 40	46·0	44·0	
1560	10 45	45·5	44·0	Sun generally behind clouds, but sky most clear.
1700	10 50	44·5	43·0	
1850	11 0	45·5	43·5	
2000	11 5	45·2	43·8	At margin of Glaslyn.
2850	11 55	42·5	41·0	Steep ascent.
3200	12 3	42·5	41·0	
3300	12 8	41·0	40·8	On ridge of Snowdon.
3570	12 15	40·2	40·0	On top of Snowdon. A cloud hung overhead, but did not descend upon the mountain; the weather was fine and calm.
	12 30	38·8	38·5	
	1 0 P.M.	38·0	38·0	
	1 20	39·0	38·8	
	2 0	40·0	39·6†	
2000	3 0	45·0	42·0	By margin of Glaslyn, at foot of precipice.
	3 5	45·5	41·5	
	3 10	44·8	41·0	
1500	3 30	47·2	44·0	

The thermometers were carried upon a stick, the bulbs projecting 2 inches from it.

* Maximum during day.

† Sun shining (thermometers in the shade of hut).

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SESSION 1868–69,

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OF

THE METEOROLOGICAL SOCIETY.

EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

1869, FEBRUARY 17.

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JAMES GLAISHER, Esq., F.R.S., President.

Vol. IV. 1869, FEBRUARY 17. [No. 41.

JAMES GLAISHER, Esq., F.R.S. &c., President, in the Chair.

The Hon. Ralph Abercrombie, 21 Chapel Street, Belgrave Square;
Peter Allen, Esq., M.D., F.R.C.S., 1 Queen Square, Westminster;
G. D. Brumham, Esq., 154 Offord Road, Barnsbury;
Rev. Henry Brown Ingram, 23 Gloucester Crescent, Regent's Park;
William Mackenzie, Esq., 10 Montpelier Street, Brighton;
were balloted for and duly elected Fellows of the Society.

XXIX. *Description of Mr. Cator's Anemometer as newly arranged with Spiral apparatus, and its Registrations from the 11th of September*, 1868, *to the 11th of February*, 1869. By C. O. F. Cator, Esq., M.A., F.M.S.

A description of my anemometer, as fitted up with the double-curved levers, was read as a paper by Mr. Glaisher before this Society in January 1866; and a short paper, giving an account of its working for two months after its erection at Beckenham in September 1867, was also read at the November Meeting of that

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year. It continued to work very well all through the winter till May 1868, when it was taken down for the summer, the three highest pressures of that winter having been 25 lbs. on the 18th of January, 28 lbs. on the 1st of February, and 21 lbs. on the 8th of March, those being the only days when pressures of 20 lbs. and upwards were shown.

Another plan for measuring the strength of the wind having in the same winter suggested itself to me, I devised the means of applying it to the instrument, and accordingly had it fitted up,—not intended as an improvement upon the levers, which may or may not be the case, and remains to be seen, but merely as it seemed to be worth a trial, it being so easy to apply it to the instrument by disconnecting the levers and connecting *it* instead. This new application is a system of double spirals, of which the following is a description:—

The other parts of the instrument being explained at length in the paper above referred to, I limit myself to the spirals. These are concentric and rigidly connected together with each other and with a horizontal rod passing through their centres, and revolve, with such rod as their common axis, in vertical planes side by side, the horizontal rod resting on strong supports at each end. The two spirals are of different sizes; the perimeter of the smaller one is equal to the length of the scale of pounds on the recording-sheet, and also to the total space through which the pressure-plate is moved, viz. about 5 inches; and round this is wound a chain, one end of which is rigidly fastened to the rod at its centre, and the other to the steel wire which comes down from the bar connected with the pressure-plate; and it is so adjusted that when it is calm, the chain is wound wholly round this spiral, and leaves it as a tangent at the point furthest from its centre, viz. about 2 inches; and as the pressure-plate is moved forward by the wind, the steel wire is lifted up, and so unwinds the chain from the spiral and causes it to leave the spiral as a tangent, accordingly, at a point nearer to its centre. The other spiral is of much larger size; and round its perimeter is wound a string, to one end of which is fastened the horizontal rod which passes though its centre, and to the other a weight, which is adapted to the size of this spiral: it is so arranged that, when it is calm, no part of the string is wrapped round this spiral, but it merely hangs direct from, or is a tangent to the curve at its centre; and as the pressure-plate is moved forward by the wind, this spiral (being rigidly connected with the

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other one) is made to revolve, and the string to be wrapped round it, leaving it as a tangent, accordingly, at a distance from its centre.

From the above it will be readily seen that the two spirals are moved through equal angles, and act reversely (or with opposite intensity), the small one being unwound while the large one is being wound, the tangential chain of the small one nearing the centre as the tangential string of the large one becomes at the same time further from it; and so the effect is doubled. The apparatus may be considered as a continual series of levers, the actual and relative lengths of the two arms from the fulcrum being gradually altered as it is made to revolve: in the first instance, a very small force applied at the pressure-plate, or, which is the same thing, at the end of the chain, will cause the apparatus to revolve, and will lift the fixed weight hanging from the centre or fulcrum; and power will always be gained, or, in other words, the pressure of wind will always be less than the fixed weight, till it has revolved through such an angle that the chain and string are at the same length of arm from the centre; and as it revolves further round, the pressure of the wind, so causing the chain to act at a shorter and shorter arm or nearer and nearer to the centre, will be always proportionately greater than the fixed weight, which will act at a longer and longer arm, or further and further from the centre. The string which carries the recording-pencil to and fro is fastened to the steel wire at a short distance above the chain belonging to the small spiral.

Thus far for the description: I will next mention one great advantage, viz. that the spiral apparatus can be very readily disconnected, and the levers again applied, or *vice versâ*, at pleasure; perhaps the whole alteration might be effected in a couple of hours or so.

I now proceed to state a few particulars of the records produced since its erection in September last, which may be interesting, especially as we have passed through an exceptionally tempestuous season.

1868.

Sept. 11. *Calm.*—The instrument commenced working on the 11th of September; and from this time till the 25th of September there was no wind of any consequence, 5 lbs. on the square foot being the greatest pressure recorded, viz. on the 13th of September, the direction having been generally easterly till the 22nd of Sep-

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tember, and two complete revolutions having taken place in a retrograde direction.

Sept. 25. *Windy*.—On the 25th of September, at 4 P.M., having changed from E. to S.S.W., a strongish wind suddenly sprung up and lasted about nine hours, the direction remaining S.S.W., the maximum pressure being 12·6 lbs. at 4.30 P.M. It continued moderately strong, with a few intermissions, till 6 P.M. of the 30th, the direction being S. or S.W. throughout, the maximum pressure being 11·8 lbs. about noon on the 29th.

Sept. 30. *Calm*.—From this time till the 23rd of October was a period of comparatively calm weather, not having been more than 4·7 lbs., including eight days very nearly calm, the direction having again made two complete retrograde revolutions.

Oct. 23. *Very Windy*.—Then, till the 5th of November, again confirming this as a windy period, known as the "Royal-Charter gale period," there were alternate intervals of wind and calm, the direction remaining between S. and N.W. all the time, with one exception, viz. from 7 to 11 A.M. on the 2nd of November, when rather more than one complete direct revolution took place from S.W. to S.W. again, and to W.N.W., immediately following a continual and steady blow for fifty-seven hours from S.W. A gale blew from 10 A.M. of the 24th of October, with a maximum pressure of 12 lbs. at 2 P.M., till 3 A.M. of the 25th of October; another from 7 P.M. of the 28th of October to 4 P.M. of the 29th, with maximum pressure of 10·7 lbs. at 3 A.M. of the 29th. Then followed two successive bodies of air, very similar in point of time and duration, the first continuously from 1 A.M. of the 31st of October to 9 A.M. of the 2nd of November, fifty-six hours, with pressures varying from 8 to 5 lbs. and a steady direction of S.W.; then a lull for fifteen hours till 1 A.M. of the 3rd of November, when the second, a greater body of air, passed over, with pressures of from 5 to 13 lbs., blowing without intermission till 5 P.M. of the 5th of November, a period of sixty-four hours, and a steady direction between S.W. and W.S.W. Within this time, viz. from 9 A.M. of the 3rd of November to 9 A.M. of the 4th of November,

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the horizontal motion of the air was as much as 843 miles, this being the greatest amount I have ever recorded in any twenty-four hours, being an average of thirty-five miles per hour.

Nov. 5. *Calm.*—Sixteen days of calm weather ensued, 5·1 lbs. being the maximum pressure, with steady northerly winds, but gradually veering to N.E.; it became E.S.E. on the 20th.

Nov. 21. *Gale.*—At noon on the 21st it became S., and from 1 P.M. of that day till 9 A.M. of the 23rd, it blew incessantly from S. to S.S.W., and during the whole of the 22nd a heavy gale prevailed; 15 lbs. the maximum pressure at noon.

Nov. 23. *Calm.*—Another calm period of ten days followed, with a prevailing easterly direction, and within which another retrograde revolution took place.

Dec. 3. *Gales.*—Then on the 3rd of December began the long-to-be-remembered period of thirty-three days, which comprised a continual succession of great gales, accompanied by unusually mild and rainy weather, which lasted, with very slight exceptions, till the 5th of January. This period may be divided into six series of gales, the first of which (*series* 1) began with a moderate gale at midnight of December 3–4, and blew continuously from S.S.W. and S.W. till 11 A.M. of the 5th of December, maximum pressure 9½ lbs. at 0.30 P.M. of the 4th of December; a lull followed for two hours, the wind backing to S.S.E., with rain: by 1 P.M. of the 5th of December it became again S.W., and another and stronger gale began and lasted till 8 A.M. of the 6th of December, maximum gust 15 lbs. at 7.20 P.M.; then another lull for four hours, the wind having backed as on the previous day to S.S.E., with heavy rain about noon. At 2 P.M. a great gale began, the pressure reaching 19 lbs. at 11 P.M., then gradually receded to 8 lbs. by 1.30 A.M. of the 7th of December; direction up to this time S.W., when there was a rather sudden shift to W.N.W., and simultaneously the pressure increased very greatly, and at 1.50 A.M. there was a terrific gust of 30 lbs., being the greatest pressure I have ever recorded: it remained excessively

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violent for about ten minutes, and gradually decreased to a gentle wind at 7.30 A.M., the direction having backed to S.W. again; a calm soon followed, the wind further backing to E.S.E. by midnight, then there was a moderate gale till 6 P.M. of the 8th. This finished the first and greatest series, extending over ninety hours, the direction during the whole time ranging between S.S.E. and W.N.W. It is wonderful whence all these bodies of air arose, and whither they dispersed themselves. A lull of thirty hours ensued, during which the direction again made a complete revolution, but this time in a forward direction.

Dec. 10. *Second series.*—This extended over just forty-eight hours, from 3 A.M. of the 10th to 3 A.M. of the 12th of December, maximum gust 11 lbs. at 8.20 A.M. of the 11th; this began with S.S.E. wind and gradually veered through S.W. to N., when it became calm, and then remained with little wind for thirty-nine hours, the direction having progressed from N. to S.E.

Dec. 13.—At 6 P.M. of the 13th of December the *third series* began with a S.E. wind; this continued, with two intervals of a few hours each, during which the wind backed 90 degrees and 45 degrees respectively, till noon of the 18th of December. These were not strong generally, the maximum pressure being 11·5 lbs. at 11.25 P.M. of the 15th; direction from S.E. to S.W. Then followed sixty-six hours with very little wind, the direction having again backed to S.E.

Dec. 21.—The *fourth series* began at 6 A.M. on the 21st, and, consisting of frequent squalls and lulls, lasted till shortly after midnight of the 24–25, the greatest pressure, 11 lbs., happening at 6 P.M. on the 24th, with thunder and lightning, direction remaining within the same limits as before. Then the wind moderated for about thirty-six hours till 3 P.M. of the 26th.

Dec. 26.—The *next (fifth) series*, viz. from this time till 6 P.M. of the 29, was remarkable for some very violent storms, with frequent heavy rain, and thunder and lightning in several parts of the country, a very heavy squall, 27 lbs. on the square foot, taking place at 4.30 P.M. of the 28th, having been preceded by several hours'

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heavy rain, and ending with a rather sudden shift of wind from S.S.W. to W.N.W. at the same time with the storm.

Dec. 29.—Between 6 P.M. of the 29th of December and 6 P.M. of the 1st of January, there were several hours of calm, with occasional moderate wind, a complete retrograde revolution taking place between 10 and 11 A.M. of the 30th; with this exception, the direction remained nearly the same, but ended by backing to S.S.E.

1869.

Jan. 1. This long windy period closed with the *sixth series* of gales, viz. from 6 P.M. of the 1st to midnight of the 5–6th of January, comprising three heavy gales; maximum 16 lbs. at 9.30 A.M. of the 3rd, direction ranging between S. and W.S.W.

Jan. 5, 6. *Calm.*—This was succeeded by a prolonged period (twenty-three days) of generally calm weather till 6 P.M. of the 28th of January, and comprising eleven days almost calm, the greatest pressure having been only 6·7 lbs. on 15th. The direction was in some cases rather peculiar; in the first twenty-four hours it backed from W.S.W. to S.S.E.; in the next it gradually went completely round the compass in a progressive direction; in the next forty-eight hours it backed again to S.E. and remained S.E. or E. for five days, then southerly for nearly four days, then made another complete direct revolution between 7 and 8 P.M. of the 18th; was S.S.E. for the next forty-eight hours, and again made a third complete direct revolution between 8 and 10 P.M. of 20th, and then continued between E. and S. to the close of the period, ending with dry frosty weather.

Jan. 28. *Gales.*—After this, another windy period set in at 6 P.M. of the 28th of January with S.S.E. wind, and continued with a succession of gales to noon of the 2nd of February, beginning with a short gale of twelve hours, followed by a calm of three hours, then an uninterrupted hard blow for 100 hours, from 9 A.M. of the 29th of January till 1 P.M. of the 2nd of February; maximum pressure 13 lbs., direction steady S.S.W. nearly all the time, except the last few hours, when it went up to W.N.W.

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Feb. 2. *Calm.*—Then four and a half days of alternately calm and slight winds till 11 P.M. of the 6th of February, the direction first backing to S., in which quarter, or at S.S.W., it remained till midnight of the 5–6th, when another direct revolution began, and was completed by 2 A.M. of the 6th, and continued S.S.W. till the next windy period, when, at 11 P.M.,—

Feb. 6. *Gales.*—Another set of heavy gales set in with a second long continuous hard blow of ninety-three hours till 8 P.M. of the 10th of February, between S.S.W. and W.S.W. throughout, several pressures of 10 to 12½ lbs. having occurred; it did not even then become calm, but continued to blow for twenty hours more, with pressures from 1 lb. to 3 lbs. and 4 lbs., till 4 P.M. of the 11th of February, making 113 hours uninterrupted in all, and became calm by 7 P.M., the direction then backing from W.S.W. to S.W., and soon after to E.N.E., with heavy rain. The horizontal motion of the air during these days was very great, viz. in the twenty-four hours up to 9 A.M. of the 8th of February, 708 miles; ditto of the 9th of February, 825 miles; ditto of the 10th of February, 751 miles; ditto of the 11th of February, 575 miles—giving an average for the four days of 715 miles per day, or very nearly thirty miles an hour.

From the above statement, abstracted from the recording-sheets, and from a close observation of the sheets themselves, both of this and previous years, a few remarks seem to suggest themselves as possible conclusions:—

1. That gales have in most cases begun with S.E. or S.S.E. wind, generally after it has backed to that quarter, with or without rain, and that after it has begun to blow it veers to S., S.S.W., or S.W., and becomes stronger; but very frequently remains at S.S.W., rain falling in smaller quantities after it passes S.S.W., and very seldom after it has passed S.W., except in showers; as the gale subsides, the direction generally slowly backs to S.S.W. or S.

2. When the wind increases in strength, the direction has either remained steady or progressed, especially with sudden shifts from S.W. to W. or N.W.; but the converse does not follow, that

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when the direction remains steady or progresses, there is always some wind, or that it is of increasing strength.

3. It appears to have been invariably true that, as the wind retrogrades, either quickly or slowly, the strength always diminishes, or else it is calm.

4. In windy weather the direction appears not to have gone through any great changes, but to have been alternately progressive with wind, and retrograde with calm; but in calm weather the changes of direction are through much greater angles; and frequently the whole compass seems to have been traversed, sometimes in short periods, as in one or two hours, and sometimes very gradually; and, again, sometimes progressive and sometimes retrograde. It seems worthy of remark that in the calm periods previous to the 3rd of December all the revolutions were retrograde, and in the calm periods since that time all, with one exception, were progressive.

Next, as to the respective character of the different winds,—

5. The strongest winds have been in the period above detailed, between S.S.W. and W.N.W., both inclusive, and the quarter from which we may least expect to have any strength is S.E.

6. Again, the S.E. appears to have been the most interrupted wind, *i. e.* alternate blow, and complete lulls between each of short duration; and the N.W. to be the most continuous blow, without any lulls or intermission; and according as it is nearer to one or the other, so it partakes more of the character of such wind. Thus, in looking at the sheets, it will be seen that, with S.E. wind, the pencil-marks are between every gust down to the zero-line, with S.W. wind only occasionally down to the zero-line, and with N.W. hardly ever. I presume this is naturally the character of these winds; but it may be that this is only due to the contour of the country and the particular position of the anemometer, viz. on the side of a gentle slope facing S.W. It would be interesting to know if this is generally the case at other stations.

7. That the vane (which in windy weather, whether slight, moderate, or strong, is continually veering backwards and forwards through a certain angle) has veered through the greatest angle, viz. about 100° or 120° with S.E. wind, and less and less as the direction gets more and more towards the west and north, till it becomes N.N.W., when the veering angle is the least, viz about 20° or 30°. It appears probable that this *may* be due to the peculiar contour of the country; but query?

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The following is a Table showing all the days from the 11th of September to the 11th of February when maximum pressures of 10 lbs. and upwards on the square foot have been recorded, with the respective directions of such maximum gusts, and the times of day at which they happened :—

Date.	Maxima.		
	Pressure per square foot.	Direction.	Time.
1868.	lbs.		h m
September 25...	12·6	S.S.W.	4 30 P.M.
,, 29...	11·8	,,	0 30 ,,
October 24.....	12·0	,,	2 30 ,,
,, 29.....	10·7	,,	3 0 A.M.
November 3...	13·2	S.W.	9 0 P.M.
,, 4...	11·2	W.S.W.	5 0 A.M.
,, 22...	15·0	S.	11 50 ,,
December 5 ...	14·8	S.S.W.	7 20 P.M.
,, 6 ...	18·7	S.W.	11 0 ,,
,, 7 ...	30·0	W.N.W.	1 50 A.M.
,, 11 ...	10·9	S.S.W.	8 20 ,,
,, 15 ...	11·5	,,	11 25 P.M.
,, 24 ...	11·2	W.S.W.	6 0 ,,
,, 27 ...	18·9	W.	1 10 ,, / 1 45 ,,
,, 28 ...	27·0	W.S.W.	4 30 ,,
,, 29 ...	10·0	W.	1 0 ,,
1869.			
January 2.....	10·6	S.W.	2 55 A.M.
,, 3.....	16·0	S.S.W.	9 15 ,,
,, 5.....	14·4	,,	9 15 ,,
,, 29.....	12·0	S.	7 0 P.M.
,, 31.....	13·0	S.S.W.	10 45 A.M.
February 1 ...	13·0	,,	2 0 ,, / 10 40 ,,
,, 7 ...	11·4	,,	10 50 P.M.
,, 8 ...	12·5	,,	Noon.
,, 9 ...	12·5	S.W.	3 0 A.M.
,, 10 ...	11·3	,,	10 55 ,,

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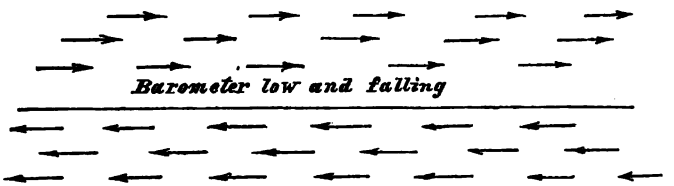
XXX. *On the Connexion between the Rotation of the Wind in the Southern Indian Ocean and the Relative Positions of oppositely directed Air-currents.* By CHARLES MELDRUM, Esq., M.A., F.M.S.

THE tropical hurricanes of the Southern Indian Ocean, so far as I am aware, *invariably* originate between two opposite streams of air, in about 6° to 12° S. lat.

These aërial currents are generally from west and east respectively, the latter being to the south of the former. Thus:—

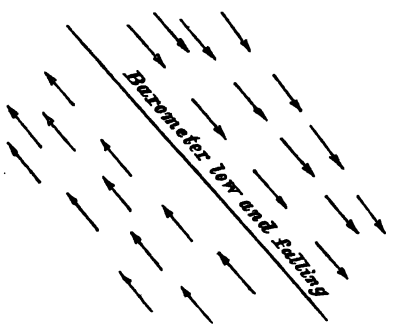
Fig. 1.



The westerly current is the N.W. monsoon, which, in this case, acquires westing in approaching its limits, and the easterly current the S.E. trade-wind, which acquires easting in approaching its limits. Between them there is a narrow belt of calms and variables in which the barometer is comparatively low and falling. As the atmospheric pressure decreases, the wind at length begins to gyrate from left to right, or with the movement of the hands of a watch, and a cyclone is formed.

Sometimes the two currents are respectively from the north-westward and south-eastward. Thus:—

Fig. 2.



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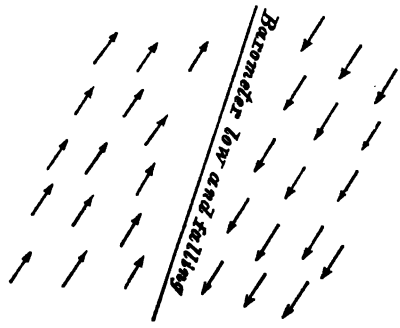
At other times the currents are from the north-eastward and south-westward. Thus:—

Fig. 3.



Now, under these conditions, it is obvious that if the wind rotate at all, it must do so in all three cases from left to right.

In the first two cases the relative positions of what may be called the generating air-currents may be explained by the earth's rotation, the westerly current (fig. 1) and the north-westerly current (fig. 2), both of which are the monsoon, coming from low to higher latitudes, and the easterly current (fig. 1) and the south-easterly current (fig. 2), which are the trade-wind, coming from high to lower latitudes. But in the third case, the north-easterly current (fig. 3) is a deflection of the monsoon, which has become first a northerly and then a north-easterly wind, and the south-westerly current (fig. 3) a deflection of the trade-wind, which has become first a southerly and then a south-westerly wind, in opposition to the effect due to the earth's rotation.

Thus far, then, it would appear that the direct (left to right) rotation of the wind in the cyclones of those latitudes depends, in the first place, upon the *relative positions* of the antagonistic currents of air.

What would be the direction of the rotation if the air-currents were reversed? I believe it would be retrograde (right to left); and observation has furnished instances of this in the southern hemisphere, though, so far as I know, none in which the wind attained hurricane force.

Between the parallels of 30° and 45° S. lat. there frequently coexist alternate bands of northerly and southerly winds, which at times show little or no sign of gyration either way, but which seem to flow side by side over several degrees of latitude, the

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transition from one to the other, as experienced by vessels at sea, being sometimes very sudden and abrupt.

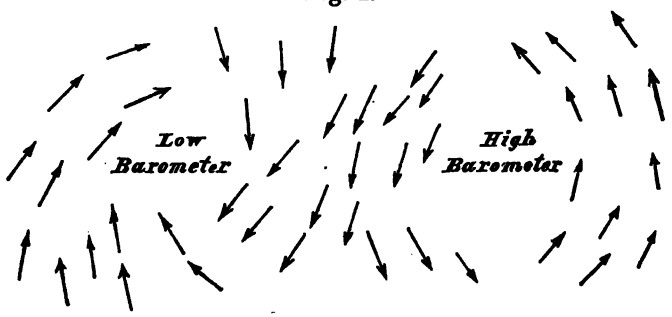
Not unfrequently, however, each current flows in an extensive curve (the incurvation being often to the extent of nearly 180°) apparently round a central axis, the vessels experiencing a gradual veering of the wind, and then a shift; and the *direction* of the rotation is intimately connected with the relative positions of the opposite currents.

The law seems to be this:—When the southerly is to the westward of the northerly current the rotation is direct; but when the southerly is to the eastward of the northerly current, the rotation is retrograde.

In the former case, the air moves round an area of low barometer, and the wind is strongest towards the centre or axis; whereas in the latter case it moves round an area of high barometer, and the wind is strongest towards the circumference.

The two systems are so connected that the same northerly current may form the east side of the system of low barometer, and the west side of the system of high barometer. Thus:—

Fig. 4.



The whole has an easterly progression; and hence the same locality undergoes alternate changes of wind and atmospheric pressure.

Attention was directed to some of these phenomena several years ago; and the Daily Weather-charts of the Indian Ocean which are being now prepared will contain examples of all of them.

If the S.E. trade-wind and the N.W. monsoon, between which the tropical hurricanes are formed, in 6° to 12° S. lat., and the alternate bands of southerly and northerly winds, between 30° and 45° S. lat., be regarded as polar and equatorial currents respec-

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tively, the law above indicated would be enunciated by saying that the rotation depends upon the relative positions of the polar and equatorial currents.

As these currents have opposite directions in the northern and southern hemispheres, so we might expect the rotation in the former to be the reverse of what it is in the latter, under the same conditions as regards the relative positions of the two currents.

I will conclude this notice with two remarks,—1st. What is called Buys Ballot's law seems to apply to both systems of rotation (direct and retrograde) in the Southern Indian Ocean. 2nd. The direct rotation of the wind around an area of low atmospheric pressure appears to be *against* the effect of the earth's rotation, but the retrograde rotation around an area of high atmospheric pressure *with* the effect of the earth's rotation.

XXXI. *Results from Meteorological Observations made at the Royal Observatory, Cape of Good Hope, from 1st of January, 1842, to 31st of December, 1861.* By Sir T. Maclear.

It is not known (nor is it likely) that a complete meteorological register was kept in Cape Town or its vicinity previous to the establishment of the Cape Observatory, except by La Caille, in the years 1751 and 1752, whose observatory was in Strand Street, Cape Town, in the yard behind the house, No. 2, at present the property of Mr. Searight; and by Sir John Herschel, from the year 1834 to 1838, at the house now occupied by Mr. Rice Jones, near Wynberg. The observations from which Colebrook derived his essay on the Cape climate are not available.

Sir John Herschel's journal is not available, nor the journal kept at the Cape Observatory from the date of its establishment in the year 1827 until the year 1834. The observations from 1834 to the year 1841 are still in manuscript.

In the year 1841 a new and improved system of observation, with superior instruments, was commenced at the Royal Observatory, which, with an unimportant modification introduced in the year 1846, is still carried on. From the last uninterrupted series this Table has been deduced.

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TABLE I. General Monthly Abstract derived from Observations during Twenty Years, from 1st of January, 1842, to the 31st of December, 1861.

Months.	Barometer at 32°.	Temperature.					Humidity.		Rain.	Cloudy Sky.	Lightning.
		Mean Temperature.	Mean Daily range.	Mean of greatest range on any one Day of each Month.	Mean of least range on any one Day of each Month.	Mean of greatest range of each Month.	Mean for each Month.	Mean Daily range.		Per cent. of visible hemisphere.	Recorded Number of Days during Twenty Years.
	ins.	°	°	°	°	°	per cent.	per cent.	ins.	per cent.	
January	29·934	69·07	11·71	26·2	8·8	30·3	67·8	21·8	0·884	28	13
February	29·931	69·25	12·47	28·1	8·1	32·2	64·4	22·4	0·664	28	24
March.....	29·969	66·67	12·69	28·7	7·9	33·1	70·4	22·3	0·830	31	33
April	30·012	63·33	11·83	27·9	5·3	35·7	74·3	21·7	1·771	40	33
May	30·067	58·14	9·39	25·2	4·9	31·2	80·4	16·0	3·774	48	29
June	30·120	55·39	8·59	23·8	4·7	28·0	81·8	13·2	4·465	49	16
July	30·161	54·39	9·11	22·3	5·2	28·3	80·7	14·0	3·283	45	10
August	30·144	55·52	9·11	23·3	5·3	29·2	79·8	14·5	3·347	46	16
September	30·100	57·51	9·49	25·1	4·9	30·6	77·2	16·4	2·492	47	17
October	30·052	61·20	10·65	26·2	7·1	32·7	72·9	19·5	1·110	40	17
November	29·987	64·49	10·81	25·5	8·4	30·0	69·5	20·2	1·120	38	6
December	29·952	67·63	11·73	26·4	9·4	29·8	67·7	21·8	0·576	29	15
Yearly Means	30·036	61·88	10·63	25·7	6·7	30·9	73·91	18·7	24·316	39	229

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Description of the Tables.

Table I. furnishes the mean for each month of the several means for each month during twenty years, ending on the 31st of December 1861, of the atmospheric pressure, temperature and range of temperature, humidity and range of humidity, rainfall, clouded sky, &c., and may be regarded as containing the first approximation to the *normal* meteorological elements of the observatory locality.

The *first* column represents the atmospheric pressure corrected to the standard temperature, 32°; in other words, the expansion of the mercurial column, for the difference between 32° and the accidental temperature of the mercury at the time of observation is subtracted from the scale readings. The *second* column gives the temperature of the open air, the thermometer of course screened from the sun and from reflected heat. The *third* gives the mean daily range of temperature in the open air. The *fourth* gives the mean of the greatest range on any day one of each month. The *fifth* gives the least. The *sixth* gives the mean of the greatest range in each month. The *seventh* gives the percentage of humidity for each month; complete saturation of the atmosphere with moisture (as when rain is about to fall) is represented by 100. The *eighth* gives the mean daily range of humidity. The *ninth* gives the mean fall of rain for each month, namely, the mean of the twenty falls in January, February, &c. The *tenth* gives the percentage of clouded sky; the visible hemisphere is represented by 100. The *eleventh*, and last, gives the total of the recorded days on which lightning was seen during the twenty years, amounting to 229.

Table II. gives the *yearly* fall of rain during twenty years to the nearest tenth of an inch.

Table III. exhibits the number of days in each month on which rain fell in the years 1752, 1858, 1859, and 1862.

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TABLE II. Giving the Fall of Rain in each Year during a period of Twenty Years, from 1842–61.

Year.	Amount of Rain.	Difference from the Mean.	Year.	Amount of Rain.	Difference from the Mean.	Year.	Amount of Rain.	Difference from the Mean.
	ins.	ins.		ins.	ins.		ins.	ins.
1842	26·3	+2·0	1849	24·6	+0·3	1856	21·9	− 2·4
1843	24·8	+0·5	1850	33·5	+9·2	1857	22·7	− 1·6
1844	18·8	−5·5	1851	20·3	−4·0	1858	24·1	− 0·2
1845	20·9	−3·4	1852	23·2	−1·1	1859	36·7	+12·4
1846	22·5	−1·8	1853	21·2	−3·1	1860	29·1	+ 4·8
1847	22·4	−1·9	1854	20·0	−4·3	1861	25·4	+ 1·1
1848	23·2	−1·1	1855	24·6	+0·3			

The mean annual fall of rain is 24·3 inches.

TABLE III. Showing the Number of Days in each Month on which Rain fell during the Years 1752, 1858, 1859, and 1862.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	Amount of Rain.
	days.	days.	days.	days.	days.	days.	days.	days.	days.	days.	days.	days.	days.	ins.
1752.	7	4	5	10	11	8	11	10	6	12	11	8	103	.....
1858.	8	5	7	8	7	8	10	14	8	10	5	3	93	24·1
1859.	6	5	4	4	12	14	13	15	6	13	6	7	105	36·7
1862.	4	6	4	5	8	15	14	15	10	14	8	2	105	32·0

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XXXII. *The Rainfall at Arbroath (latitude 56° 33′ 35″ N., longitude 2° 35′ 30″ W. of Greenwich) for Twenty-six Years.* By Alexander Brown, Esq.

Months.	1843*	1844.	1845.	1846.	1847.	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
January	...	2·4	2·6	2·6	2·0	1·7	3·1	2·7	3·9	4·9	3·3	2·6	1·4	3·0
February ...	...	3·1	1·6	0·9	0·3	5·8	1·4	2·2	0·9	1·4	2·8	0·9	1·5	2·8
March.....	0·9	1·7	1·8	1·3	0·7	3·0	0·8	0·3	4·3	0·6	1·0	0·8	3·1	0·1
April	3·3	0·7	1·4	2·8	1·4	2·4	1·4	1·8	2·5	0·3	1·0	0·2	0·6	3·1
May	2·3	0·5	1·5	2·1	4·9	0·7	2·3	2·4	0·5	1·4	1·0	2·8	1·6	2·9
June	1·9	3·3	3·5	1·5	1·8	5·3	2·0	1·4	2·1	2·6	2·0	2·7	1·6	3·2
July	4·8	3·5	2·7	4·2	2·4	2·6	3·4	1·5	2·6	1·7	2·5	1·6	1·6	2·1
August	2·2	1·9	2·8	2·4	1·0	1·9	1·5	2·9	2·6	1·8	3·0	1·5	3·7	3·8
September ...	0·6	2·5	2·1	2·4	0·7	1·0	1·2	2·0	1·0	1·4	1·5	1·1	0·5	5·4
October	3·4	1·1	4·3	5·6	3·1	4·2	1·2	1·7	1·3	3·2	4·9	2·0	2·0	1·5
November ...	3·0	4·2	2·6	2·8	1·7	2·1	2·1	2·6	1·1	4·6	2·8	3·4	1·3	2·0
December ...	0·3	1·4	1·4	1·1	5·3	2·3	3·1	1·4	0·5	5·4	1·8	1·3	2·3	2·3
Sums	22·7	26·3	28·3	29·7	25·3	33·0	23·5	22·9	23·3	29·3	27·6	20·9	21·2	32·2

Months.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	Average of 26 Years.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
January	2·0	0·9	1·2	3·4	1·8	3·3	2·7	1·8	2·1	2·6	5·5	3·6	2·69
February ...	1·1	1·0	1·3	1·0	1·7	1·9	0·5	2·9	2·9	2·5	1·2	1·9	1·83
March	2·7	1·3	2·6	2·0	1·9	3·2	0·8	3·0	1·3	2·4	2·0	1·9	1·83
April	3·3	1·3	2·1	0·8	1·3	1·4	1·3	1·3	1·0	1·3	2·5	2·7	1·66
May	3·1	2·1	0·3	1·2	1·2	4·0	1·6	1·6	2·3	1·6	3·5	2·0	1·98
June	2·7	1·5	2·7	4·8	2·5	2·8	2·5	2·1	0·4	1·0	1·4	0·4	2·30
July	1·0	3·1	2·4	1·9	2·6	3·6	1·2	2·5	3·5	2·2	4·7	0·3	2·54
August	1·6	2·3	1·4	3·0	4·7	2·6	3·9	0·8	4·4	2·2	2·8	5·3	2·61
September ...	2·6	2·0	1·7	1·0	4·2	2·0	3·7	3·7	0·5	2·9	1·7	4·7	2·08
October	1·3	2·7	4·1	2·5	2·0	3·0	2·5	7·8	4·1	2·0	3·6	2·3	2·97
November ...	2·4	1·9	3·2	4·3	3·5	0·9	2·2	2·9	3·5	2·0	0·5	1·3	2·42
December ...	1·0	4·3	2·2	4·4	2·1	2·5	1·8	3·5	1·9	3·0	1·1	7·2	2·50
Sums	24·8	24·4	25·2	30·3	29·5	31·2	24·7	33·9	27·9	25·7	30·5	33·6	27·41

N.B. The observations were taken to the third place of decimals, but have been contracted to the first place for the above Tables. The last column shows the monthly average rainfall for the twenty-six years by the original observations.

The above Table embraces an abstract of rain-register for a period of nearly twenty-six years, from the beginning of March 1843 to the close of 1868; it contains the amount of rainfall in every month and the total rainfall in each year. It appears that—

* Ten months.

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	ins.
The average annual fall over twenty-six years is	27·4
The highest annual fall being in 1864	33·9
The least „ „ „ 1854	20·9
The greatest monthly „ „ 1864, October	7·8
The least „ „ „ 1856, March ...	0·1

The rain-gauge is 60 feet above the mean sea-level, and 2 feet from the ground. The same form and size of gauge has been used throughout, and its position has never been altered. The diameter of the receiving surface is 7·5 inches.

Taking the average monthly fall of January and February for twenty-five years, as given in the Table, viz. 2·69 ins. and 1·83 in. respectively, it would give a total amount of rainfall for 1843 of 27·2 inches; and throwing the twenty-six years over which the observations extend into groups of four years each, we find the average of mean annual rainfall:—

	ins.		ins.
1843 to 1846.....	27·9		
1847 „ 1850.....	26·2	Average of the first twelve years	26·5
1851 „ 1854.....	25·3		
1855 „ 1858.....	25·7		
1859 „ 1862.....	29·1	Average of the second twelve years	27·6
1863 „ 1866.....	28·1		
1867 and 1868.....	32·0		

CORRESPONDENCE, &c.

Description of Solar Halos seen the 24th of January, 1869. By M. REITHAMMER, Pettau, Styria.

On Sunday the 24th of January, at noon, when the sun was in mid-heaven, the firmament was partly, and particularly about the sun, filled with fine vapour: around the sun two rainbows glittered; two other rainbows appeared in ellipses upon the rainbow-circle about the sun; also, towards the north, was seen upon the ground a reversed rainbow. After this had lasted some minutes, three air-images of the sun (false suns) made their appearance. There were some minute rainbows and suns visible; then the former gradually disappeared and the suns above were visible. Some minutes afterwards, these also disappeared, and the firmament completely cleared up about the sun.

This phenomenon might have been observed by any one during sixteen minutes.

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To the Editor of the Meteorological Proceedings.

Over Court, near Bristol,
24th of February, 1869.

DEAR SIR,—The remarkable depression of atmospheric pressure during the month of December 1868 is so similar to that which occurred towards the close of December 1821 that I copy and forward you the movements of the barometer (reduced to sea-level) on that occasion from the 'Proceedings of the Meteorological Society,' vol. i. p. 206, on the chance of your not having already noticed the similarity.

"1821.

	8 A.M. ins.		2 P.M. ins.		10 P.M. ins.
"December 11	.....	.....	30·36	.....	.....
21	29·18	.....	29·42	.....	29·56
22	29·56	.....	29·44	.....	29·18
23	29·15	.....	29·26	.....	29·34
24	28·94	.....	28·67	.....	28·29
25	28·57	.....	28·60	.....	28·65
26	28·46	.....	28·67	.....	28·87
27	28·97	.....	29·03	.....	29·12
28	28·55	.....	28·15	.....	28·18
29	28·57	.....	28·87	.....	29·13
30	29·29	.....	29·38	.....	29·77
31	30·07	.....	30·13	.....	30·17

And on January 19, 1822, the barometer rose to 30·58 ins."

It may be also worth while noticing the remarkable accordance in certain points between the winters of 1862–63, 1868–69, and those of 1789–90, 1795–96.

Mr. Brumham has pointed out (Proc. Meteor. Soc. vol. iv. p. 89) the following remarkable law:—"When the mean temperature of December is more than 2° above that of November, the remainder of the winter, or rather the winter quarter (consisting of the months of January, February, and March), will always have a mean temperature considerably above the average."

Since 1771 up to the time of his writing, six instances of this law had occurred; the present year is affording a seventh. The instances are:—1789–90, 1795–96, 1827–28, 1842–43, 1851–52, 1862–63, and 1868–69.

Now it will be observed that an example of the law occurred in 1789–90 and another in 1795–96, *the second occurring just six years after the first*; this has been repeated with remarkable exactness *within the last six years*, an example of the law having occurred in 1862–63 and another in 1868–69.

Faithfully yours,
R. C. CANN-LIPPINCOTT, F.M.S.

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OF

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SESSION 1868–69,

25 GREAT GEORGE STREET, WESTMINSTER, S.W., AT 7 P.M.

1868. November	18	1869. March.....	17
1869. January	20	„ April	21
„ February.....	17	„ June	16

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PROCEEDINGS

OF

THE METEOROLOGICAL SOCIETY.

EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

1869, MARCH 17.

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PROCEEDINGS

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JAMES GLAISHER, Esq., F.R.S., President.

Vol. IV. 1869, MARCH 17. [No. 42.

JAMES GLAISHER, Esq., F.R.S. &c., President, in the Chair.

The Names of two Candidates for admission into the Society were read.

XXXIII. *On the Storm of February* 12, 1869.

By James Glaisher, Esq., F.R.S., &c.

At the last Meeting of this Society I promised to investigate the particulars, as far as I might be able, of the remarkable storm which on the preceding Friday had passed over London. From the accounts with which I have been furnished I find that it first impinged on England at the Land's End, and reached Penzance before noon, where a barque was driven on shore and wrecked; the direction of the wind having been S.W., changed suddenly to N.W. At Falmouth, lat. 50° 10′ N. and long. 5° 3′ W., a gale was experienced so remarkable in character as to attract the attention of every one; the temperature decreased 6°, and the wind changed from S.W. to N.W. At Barnstaple, lat. 51° 4′ N. and long. 4° 1′

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W., it was only known by the unusual circumstance that the temperature was found to be 7° lower at 3h P.M. than it was at 9h A.M.; this place was therefore within the influence, but approximating to its northern limit. At Taunton, lat. 51° 3′ N. and long. 3° 6′ W., the direction of the wind in the morning was stated to be N.W., and to be N.W. at 3h P.M.; but at 3h P.M. the reading of the thermometer was 8° lower than in the morning, and the storm had evidently passed at this time. At Bristol, lat. 51° 30′ N. and long. 2° 30′ W., Mr. Lippincott says there was a heavy snow-storm till 3h P.M., when the wind rose and changed to N.W.; therefore the storm reached here about 3h P.M. At Bath, lat. 51° 23′ N. and long. 2° 21′ W., the reading of the barometer at 9h A.M. was 29·76 ins., at 12h 30m P.M. it was 29·42 ins., and at 4h P.M. it was 29·77 ins.; from these it is evident the storm had passed Bath some considerable time earlier than 4 o'clock P.M.

At Wilton, lat. 51° 4′ N. and long. 1° 51′ W., at 1h A.M. the barometer-reading was 29·70 ins., the temperature 51°, and wind S.W; at 2h 30m P.M. the barometer was 29·42 ins., the temperature 42°, and the wind N.W. At 4h P.M. the barometer-reading was still lower, viz. 29·306 ins., and temperature 40°·5, with wind N. It is clear that the storm in its intensity, at about the time of lowest reading of the barometer, was somewhat after 2h 30m P.M.

At Osborne, in the Isle of Wight, lat. 50° 46′ N. and long. 1° 17′ W., the wind, which was south, with 1 lb. pressure at 9 A.M., increased suddenly, just before 3h P.M., to 15 lbs.; direction at that hour S.W., and at 4 P.M. direction W.N.W. and force 14 lbs. Therefore the storm reached here before 4 o'clock. At Oxford, which is nearly in the same longitude as the Isle of Wight, the change was decided, but took place at 2h 15m P.M.; this was just within the northern limit of the stream of air.

At Bournemouth, lat. 50° 41′ N. and long. 1° 51′ W., on the coast and near the southern boundary of the stream, Mr. Compton observed his barometer at 2h P.M., when it was 29·565 ins., and temperature 50°·5; a gale of wind was blowing from the west, and feeling a sudden alteration in temperature, he took another reading at 3h 30m and found the barometer-reading 29·78 ins. and temperature 41°·8, with gusts from W. to N.W. Therefore the storm had reached here before 3h 30m P.M. At Marlborough, lat. 51° 25′ N. and long. 1° 40′ W., which is in the same longitude nearly as Bournemouth, the reading of the barometer was at 9h A.M. 29·420 ins., with temperature 42°, and wind E.; at 3h P.M. the

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barometer-reading was 29·068 ins., witht emperature 39°, and wind N. Therefore the storm seems to have reached Marlborough a little earlier than at Bournemouth.

At Strathfield Turgiss, in lat. 51° 20′ N. and long. 1° 2′ W., at 9^h A.M. the barometer-reading was 29·75 ins., with temperature 42°, wind S.W.; at 3^h P.M. the barometer-reading was 29·30 ins., with temperature 51°, and wind S.W.; therefore at this time the storm had not reached this place.

At 3^h P.M. the storm had not reached Weybridge Heath in long. 0° 29′ W.

At Kew Observatory, in long. 0° 19′ W. and lat. 51° 28′ N., the wind suddenly changed from S.W. to N.W. at 4^h 20^m P.M., and the temperature began to decline and decreased more than 11° in a quarter of an hour; the barometer-reading turned to increase, and increased nearly 0·3 in one hour.

At Harrow, long. 0° 21′ W. and lat. 51° 35′ N., it was also felt at 4^h P.M.

At Worthing, long. 0° 23′ W. and lat. 50° 49′ N., the change of temperature took place a little after 4^h P.M.

At Westminster, Mr. Eaton observed the change of the wind from S.W. to N.N.W. at 4^h 35^m, and he observed that from 5^h to 5^h 15^m, the reading of the barometer increased at the rate of 0·346 inch per hour.

At Camden Town, Mr. Symons read the barometer at 4^h 15^m, and says, half an hour afterwards (that is, at 4^h 45^m) the sudden increase of wind-force took place.

At Greenwich the wind suddenly changed from S.W. to N.W. the temperature began a fall of 11° at 4^h 45^m, the barometer reading increasing 0·3 inch in an hour, being the most rapid ever known at Greenwich.

At Haverhill, long. 0° 23′ E. and lat. 52° 5′ N., the change took place at 4^h 50^m P.M.

At Tunbridge Wells, long. 0° 12 E. and lat. 51° 9′ N., the stream passed over at 4^h 57^m P.M.

At Heyfordbury, Hertfordshire, at 5^h.

At Castle Headingham, Essex, at 4^h 45^m.

At Chelmsford, at 5^h 10^m.

At Dunmow, Essex, between 5^h and 6^h.

At Canterbury, at 6^h 30^m, lat. 51° 16′ N. and long. 1° 1′ E., and left the coast about 7^h P.M.

The storm, therefore, passed at the rate of a little more than

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thirty-five miles per hour; and this rate agrees very nearly with the times recorded at all the places except Oxford; and I am at a loss how to reconcile this time with all the rest.

The centre of the storm appears to have passed a little south of London and Greenwich, where the most rapid decrease of reading of the barometer, the most rapid increase, the most sudden change of wind, and the largest increase in the barometer-reading of any place occurred; London and a little south of it must have been situated very near the centre of the storm.

It seems that the axis or centre of the storm was first E.S.E., then E., and finally E.N.E. for the times when the storm was passing longitudes 5° to 2° W.; places situated north were somewhat earlier under its influence than those in the south in the same longitude. On approaching long. 1° W., all stations in the same longitude were under its influence simultaneously, and afterwards the more southern felt the storm somewhat earlier than the more northern in the same longitude; thus the storm appears to have been a stream of air about 100 miles in width, moving first E.S.E., reaching England at Cornwall, passing over Devonshire and all the southern counties successively, and finally over Kent and Essex, and there leaving England, its southern boundary including all the south coast of England, but did not seem to reach much further south, and certainly not so far south as Guernsey. Its northern limit appears to have been bounded by the Severn, and to have passed south of Gloucester, a little north of Oxford, Royston, and Haverhill, and south of Lowestoft. It scarcely seems to have reached in a sensible degree either Gloucester, Bedford, or Cambridge. It was not experienced at all in Wales, the midland counties, Norfolk, or any place still further north.

Remarkable as this stream of air was, the weather was equally so over the country. Whilst in some parts no rain fell, as in Cumberland, Lancashire, Yorkshire, and north of these counties, very heavy rain fell at other parts, particularly in the counties of Norfolk, Suffolk, and Cambridge, where the fall amounted to from 1 in. to 1·6 in. at different places.

In the southern and midland parts of Wales heavy rain fell; but very little in the north of Wales; at most places in the midland counties rain fell on this day. In Norfolk the snow which fell was remarkable for the size of its flakes.

I have to express my best thanks to Dr. Stewart, of the Kew Observatory, for allowing me to see the photographs traced on

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this day at the several stations, and to make free use of the information; to W. H. Richards, Esq., Penzance; W. P. Dymond, Esq., F.M.S., of Falmouth; M. P. Moyle, Esq., Helston; Dr. Barham, Truro; Thomas Mackrell, Esq., Barnstaple; Professor Matthews, St. David's College, Lampeter; J. Ingleby Mackenzie, Esq., F.M.S., Sidmouth; Dr. Moffat, F.M.S., Hawarden; John Hartnup, Esq., F.R.A.S., Liverpool; S. Elliott Hoskins, Esq., M.D., F.R.S., F.M.S., Guernsey; E. Toller, Esq., F.M.S., Gloucester; D. Smith, Esq., F.M.S., Birmingham; Thomas Challis, Esq., F.M.S., Wilton; Dr. Compton, F.M.S., Wilton; J. R. Mann, Esq., Osborne, Isle of Wight; Rev. R. Main, F.R.S., F.M.S., Oxford; J. W. Jeans, Esq., F.M.S., Grantham; J. Gledhill, Esq., F.M.S., King's Cross, Halifax; L. J. Crossley, Esq., F.M.S., Halifax, who favoured me with his original records of his self-registering anemometer; William J. Harris, Esq., F.M.S., Worthing; G. J. Symons, Esq., F.M.S., Camden Town; Hale Wortham, Esq., F.M.S., Royston; S. H. Miller, Esq., Wisbech; Rev. F. W. Stow, F.M.S., Tunbridge Wells; Rev. W. Previté, F.M.S., Little Wratting, Haverhill; J. Davidson, Esq., Holkham; H. S. Eaton, Esq., F.M.S., Westminster; C. O. F. Cator, Esq., F.M.S., Beckenham; Henry St. John Joyner, Esq., Harrow-off-the-Hill; G. Warren, Esq., Cambridge.

XXXIV. *On Comparative Observations of Solar Radiation.*

By Rev. FENWICK W. STOW, M.A., F.M.S.

I THINK that all will admit that observations of solar radiation are not at present available for comparison. Some observers use an ordinary maximum thermometer placed at the back of the thermometer-stand, others a similar instrument placed on the ground; others use a thermometer with a black bulb placed on the grass, others the same instrument raised some height above the ground. Others, again, use the black bulb *in vacuo*, but are not agreed where it is to be placed.

It is very far from my intention to undertake the thankless office of setting everybody right. I do not wish observers to relinquish their own ways of observation, or the objects which they have had in view, such as finding the amount of heat received by vegetation. All I wish for is to induce some observers to join with

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me in endeavouring to obtain, as a daily meteorological element, an expression for the comparative force of solar radiation *alone* at their different stations.

For this purpose it is necessary, of course, in the first place to have instruments which under similar conditions read alike; and when such instruments are procured, we must place them so that the difference in their indications may be due to actual differences in the power of the sun's rays, or in conjunction only with known quantities, such as the temperature of the air.

I shall, therefore, first state what I have to say about instruments, and then go on to discuss the more difficult question of position.

So far as I am aware, none of the instruments known as actinometers or pyrheliometers would be convenient for ordinary daily observations. Indeed, unless we have registering instruments, none but those who have much leisure could take observations of this kind. On the other hand, the ordinary unblacked maximum thermometer is out of the question; and though useful when the bulb is blackened, it is so much affected by wind that observations at an exposed station could not be available for comparison with those taken at a sheltered place, nor could those taken in windy weather be compared with those on a calm day. There remains only the maximum thermometer with blackened bulb enclosed in a glass jacket from which the air has been exhausted, commonly called the "black bulb *in vacuo*."

The instruments of this construction do not, however, always give identical observations. More than two years ago my attention was attracted to this fact by observing that one with a small bulb covered with lamp-black gave no higher reading than one of the old instruments with a larger bulb of bright black glass. I soon afterwards found that one with a large blackened bulb read 6° to 8° higher than another with a very small similar bulb. I felt convinced, therefore, that the cause of these anomalies must be connected with the size of bulb.

I obtained four of these instruments with bulbs of different sizes, and placed them side by side on a carefully selected piece of grass. The result was that the largest bulb gave the highest, and the smallest bulb the lowest readings, the reading of all four being exactly in order of size of bulb.

I could see but one reason for this result. The bulb covered with lamp-black would, of course, be much hotter than the un-

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covered stem, and therefore the heat would be conducted away from the bulb to the stem. The tubes are generally of about the same diameter; and thus a larger bulb would be less affected by this loss of heat than a smaller, and must give a higher reading, which I had ascertained to be the case.

I determined to test this by getting some thermometers made in which the lamp-black was carried about an inch above the bulb. If it should be found that one of this construction, with a small or medium-sized bulb, read rather higher even than that which had the largest bulb of those blackened only on the bulb, there could no longer be any doubt that the loss of heat by conduction was the main cause of the difference of reading. And if, moreover, the thermometers with the lamp-black carried up the stem should be found under similar conditions to agree closely, then the source of discrepancy was removed. The experiment succeeded almost beyond my hopes. The new thermometers read *higher than any of the rest, and they all read alike.* They were not, indeed, much in excess of other solar thermometers *in vacuo* which had large bulbs (and since that time I have seen one, which Mr. Symons was good enough to lend me, with a very large *oval* bulb, which, though apparently less sensitive in sudden gleams, comes up to them in steady sunshine); but they exceeded one that had a very small bulb by no less than 10° on an average, and on one occasion even by 14°. I have since compared, in bright sunshine, many solar thermometers *in vacuo* with the stems thus blackened, and I have always found their readings pretty closely coincident. More than half of them agree within 1°, nine-tenths within 2°, and all, as far as I have seen, within about 4°; the larger differences being due to some accidental irregularity in the instrument, such as flaws in the glass, or the bulb not being in the centre of the globular part of the vacuum-glass. It is not unreasonable, therefore, to say that solar thermometers, *in vacuo*, in which the bulb and one inch of the stem is covered with lamp-black, are available for strictly comparative observations of the amount of solar radiation. Those in which the lamp-black is not extended to the tube will also do well enough for this purpose, if compared in sunshine with one of this kind, and the correction so found applied to the reading. This correction will not be large if they have good-sized bulbs. For independent observations they are, of course, as good as any others; but where comparative observations

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are desired, I should perfer those which have an inch of the stem blackened.

II. Now comes the question—How are instruments to be placed so as to yield comparable results?

I shall first touch on a minor matter—the angle at which they should be presented to the sun. I obtained from Mr. Casella a number of solar thermometers *in vacuo*, made on the improved plan I have suggested, and compared them with great care in bright and steady sunshine, placing them side by side, first on a board, and then with the glass bulbs exposed to a free circulation of air, and frequently interchanging their positions. I took forty observations, and from the means thus obtained, which scarcely differed from the means of any one set of ten observations, I obtained numbers which I applied as corrections to each instrument, using as a standard one which had been verified before it was enclosed in the vacuum-glass, and the readings of which agreed nearly with the mean of the eight. Of the corrections of the other seven, four did not exceed 0°·5, two were 1° and 1°·2 respectively, and one was 2°·8.

I then arranged them on a circular wire stand, with the bulbs outwards and projecting beyond the stand; and by carefully turning the stand every five or ten minutes, I contrived to keep one with its bulb exactly pointing (in horizontal direction) towards the sun; the others directed towards a point on the horizon 22°, 30°, 45°, 60°, 90°, and 180° respectively distant from that towards which the first was pointed. I made observations on five days, while the sunshine was steady, with the following results. When the altitude of the sun was less than 30°, the thermometer directed towards it was from 3° to 5° below that at 45° angular distance; that at 22° angular distance was 2° to 3° below the same, and that at 180° (*i. e.* completely turned away) was 6° or 7° below. The rest (that is, those at 30°, 45°, 60°, and 90°) gave all the same results within 1°. When the altitude of the sun was between 30° and 37°, similar results were obtained, but the differences were smaller by about 2°. As it was the end of September, the season did not admit of my observing the result of a higher altitude of the sun; but I think we may conclude that in summer the effect of angular direction would hardly be appreciable, unless the bulb is completely turned away from the sun. But since, at the equinox, there is undoubtedly a difference, and in winter probably a large one, and this difference cannot with any certainty be

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allowed for, being due probably to the vacuum-glass being thicker near the end of the instrument, I conclude that it is not desirable that the bulb should be placed directly towards the midday sun, but that it should be turned away to E. or W. through an angle of about 55°, so that between 10 A.M. and 2 P.M. the sun may have its full effect on the bulb. If this is done, the observations will so far be quite comparable.

We now come to the important question—What position is best for thermometers *in vacuo*, when it is desired to make strictly comparative observations of solar radiation, irrespective of the state of the soil or of vegetation?

I determined to try five different positions—(1) cut lawn grass; (2) a black board placed on the ground; (3) a black board sheltered by being sunk 4 inches below the level of the grass; (4) a black board exposed by being raised 3 feet above the ground; (5) exposure to a free circulation of air at 4 feet above the ground. In order to find whether the excess of the temperature of the bulb above that of the external glass was at all influenced by position, I attached to the external glass jacket of each of these thermometers *in vacuo* a small unblackened mercurial maximum thermometer, the bulb of which, being scarcely, if at all, more absorptive of the solar heat-rays than transparent glass, might be expected to furnish a tolerably accurate indication of the temperature of the glass to which it was attached. Care was taken, in the case of the thermometers placed on boards, to place the attached thermometer so as to be equidistant from the hot surface with the enclosed black bulb, in order that it might represent as nearly as possible the average temperature of the whole glass envelope. In the case of the thermometer on the grass, however, owing to the irregularity of the surface, the result thus given could only be considered a rough approximation.

The following is the mean result of twenty-eight observations taken between the 4th and 13th of September, and of forty observations on the first seven days of September, respectively, there being bright sunshine on every day:—

Period.	On Grass.	On black board.	On sheltered board.	On exposed board.	In air at 4 feet.	Air in shade at 4 feet.
	°	°	°	°	°	°
4th to 13th.....	133·8	129·0	132·5	125·0	119·2	74·1
1st to 7th	137·1	133·5	138·6	.....	123·1	78·0

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In every different position, therefore, there was a different reading. Nor was this due to exceptional weather; for the means of all the daily maxima in September were:—

On grass.	On board.	On sheltered board.	In air at 4 feet.	Air in shade at 4 feet.
° 127·2	° 122·7	° 125·5	° 116·8	° 68·8

But in spite of these great differences in the temperature registered in each position by the black-bulb thermometer *in vacuo*, the difference between that temperature and that registered by the attached unblackened thermometer was very nearly the same in all cases. These differences, indicating approximately the effect of direct sunshine on the bulb in raising its temperature above that of the external glass, were as follows:—

Period.	On grass.	On board.	On sheltered board.	On exposed board.	In air at 4 feet.
	°	°	°	°	°
4th to 13th of September...	45·1	41·1	42·9	41·4	41·0
1st to 7th „ ...	44·4	41·9	43·6	.....	40·0
Whole month	43·8	41·1	41·1	.....	42·1

It is clear, therefore, that *the heating-power of direct sunshine on the bulb of a thermometer* in vacuo *is in no way affected by the position of the instrument*, and that *the difference of the temperatures registered in different positions depends only on the temperature which is acquired by the external glass.*

When a black-bulb thermometer *in vacuo* is exposed to the sun, the heat-rays are partially absorbed by the glass, the temperature of which, therefore, rises above that of the air, to a small extent even when the air circulates freely around the instrument; but when the instrument is placed on the ground, the heat of which, as well as of the air next to it, is much greater, this slight excess becomes a large and fluctuating quantity, which forms part of the temperature registered. Now this excess of temperature of the external glass above that of the air is liable to be affected by all those causes which affect the indications of an ordinary instrument, as wind, contact of other substances, &c. It follows that, if we wish to get at the effect of the direct rays of the sun only, we ought to place our instruments in a position

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where the temperature of the external glass differs from the temperature of the air by a quantity as small, and as little subject to fluctuation, as possible.

It will be seen by this Table how much less this fluctuation is in the case of the thermometer *in vacuo* at 4 feet than in other positions.

During the month of September, on days when there was equally bright sunshine, the excess of the temperature of the external glass above that of the air varied—

		Extreme fluctuation.
On grass.....	from 23°·0 to 6°·5	16°·5
On black board	from 20·3 to 7·0	13·3
In air at 4 feet	from 7·7 to 3·0	4·7

Perhaps this may be made still clearer by contrasting two days, September 11, when there was a cloudless sky and a gentle breeze, no rain had fallen for more than a fortnight, and the ground was heated by continuous warm weather, with September 29, when there was bright sun after heavy rain, with an exceedingly rough wind amounting to a gale.

Readings of Solar Thermometers *in vacuo* and Thermometer in Shade.

Days.	On grass.	Attached Thermometer.	In air at 4 feet.	Attached Thermometer.	Air in shade.
	°	°	°	°	°
September 11...	140·0	96·2	119·0	77·0	73·0
„ 29...	112·0	69·5	108·0	66·5	63·0

Since the difference between the readings of the thermometer *in vacuo* at 4 feet and its attached thermometer was, on the 11th, 44° on grass and 42° at 4 feet, and on the 29th, 42°·5 on grass and 41°·5 at 4 feet, it is clear that the direct heating-power of the sun's rays on the bulb was very nearly the same on both days; and yet the apparent amount of solar radiation shown by the instrument on the grass was 28° more on the 11th than on the 29th. This difference was due partly to the greater force of the wind on the 29th, but chiefly to the different condition of the ground, which affected the external glass of that instrument, though not of the other.

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Excess of Readings of Thermometers attached to external glass of Thermometers *in vacuo* above the Temperature of Air.

Days.	On grass.	In air at 4 feet.
	°	°
September 11.....	23·0	4·0
„ 29.....	6·5	3·5
Difference	16·5	0·5

Amount of Solar Radiation shown by the excess of Reading of Black-bulb *in vacuo* above Air-temperature.

Days.	On grass.	In air at 4 feet.
	°	°
September 11.....	67·0	46·0
„ 29.....	49·0	45·0
Difference	18·0	1·0

It will readily be seen from these figures that the excess of the reading of the black-bulb *in vacuo* at 4 feet is due almost entirely to the direct rays of the sun only, which is not the case in other positions. Exposed to a free circulation of air, the external glass becomes so little heated above the temperature of the air on the calmest day, that it cannot be much cooled on the roughest; while it is wholly unaffected by the temperature and humidity of the ground, and the condition of vegetation, by which instruments placed on the grass are so much affected. Taking twenty bright and sunny days, I found that on ten rough days on which the wind had a mean estimated force of 2°·7 the attached thermometer at 4 feet read 3°·4 higher than the temperature of the air; on ten calm days, when the force of the wind was less than 1°, its temperature was still only 5°·5 above that of the air,—the amount of solar radiation indicated being on the calm days 47° and in the rough days 46°·2, a difference of only 0°·8 in favour of the calm weather, whereas on the grass the difference was 3°, and on the boards from 6° to 9°.

Since, then, the solar thermometers *in vacuo*, when exposed to a free circulation of air at 4 feet, are so very little affected by anything except the direct rays of the sun, whereas in other positions they

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are very much affected, the conclusion is obvious that when comparative observations are required, no other position is nearly as good. If so placed near the shade thermometers the excess of their reading above the maximum temperature of the air will furnish us with a ready test of the comparative amount of solar radiation at different places or times. It is true they cannot tell us the absolute heating-power of the sun's rays, but they will furnish a most delicate test of the varying degrees of its intensity, which is what is required.

I must take this opportunity of expressing my thanks to the President of this Society, Mr. Glaisher, for kind and helpful suggestions, to Mr. Symons for much valuable assistance, and to Mr. Casella for the excellent instruments which I used, and the courteous attention he has invariably paid to my suggestions.

I will only conclude by expressing a wish that I may induce a few of the Fellows of this Society to take observations in the way which I have indicated. I do not wish them to give up their former mode of observation, but to add this to it. If this is done I am sure the comparison of the sun's power will give some most interesting results.

I shall venture to recapitulate my suggestions of what is requisite:—

1. Well-made maximum thermometers *in vacuo*, with the bulb and 1 inch of the stem covered with lamp-black, or else previously compared in full sunshine with those so constructed.

2. These thermometers to be hung 4 feet above the ground, so as to allow a perfectly free circulation of air round the globular part of the vacuum jacket. If possible, they should be placed near the shade thermometers.

3. The bulb to be directed to the S.E. (or S.W. if more convenient); the direction I prefer is S. 55° E., or about S.E. by E.

4. The daily maxima to be observed, and their excess above the maxima of the air to be considered the amount of solar radiation.

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XXXV. *On the Meteorology of England during the Years* 1867 *and* 1868. By JAMES GLAISHER, Esq., F.R.S., &c.

[PLATES VIII. & IX.]

THE year 1868 will be recorded in our annals as one of the most remarkable with respect to long continuance of high temperature, to the unusual distribution of rain, and to the early season of vegetation generally.

At the request of the Council, I have taken the annual means of the different elements at the different stations, both for the years 1867 and 1868, that the principal meteorological elements may be preserved in our Proceedings.

The monthly mean pressure of the atmosphere over England in the years 1867 and 1868 are shown in the accompanying diagrams at a few places in the extreme south, in the middle, and in the extreme northern stations: at all intermediate places the curves were found to be in close accordance in both years with adjacent stations; but comparing those of the extreme south with those of the extreme north, it was found that the form of the curves was remarkably different. This difference, however, was clearly traceable, and the change, though scarcely noticeable in comparing adjacent curves, became perceptible and clearly shown on comparing the curves of south stations with those of midland, and, again, with those of north stations: for this reason the curves belonging to a few stations only have been laid down, sufficient to show the gradual change; for instance, in the year 1867 the mean atmospheric pressure, at southern places, was greater in April than in March, was nearly the same in both months in lat. 51° to 52°, and was much less than March in extreme northern stations, the change being gradual from station to station; so also with respect to other changes of form of the curve. And this remark is applicable to the curves of the year 1868, viz. that the change of form at south stations, as at Guernsey, differed from that at north stations, as at Culloden. Comparing, however, the curves of 1867 and 1868 together, there is a very marked difference. In the year 1867 the maximum mean reading of the barometer occurred in November at all stations; and the minimum, at southern stations in January and March, at midland stations in January or April, but at extreme northern stations in April. In 1868, to lat. 51°, the maximum was generally in February, with a second very high maximum in June; from lat. 51½°, the

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maximum was in June, except at Culloden, where it took place in July. The minimum was in December everywhere, the decrease from November being large in the south and increasing gradually to very large in the north.

The mean monthly temperature of the air was found in like manner, when laid down on diagrams for all places, to agree very closely together at adjacent stations, but to differ sensibly on comparing extreme south with extreme northern stations; a few places only, as in the case of atmospheric pressure, have been selected and laid down, and which are found to be quite enough to represent the leading facts.

In the year 1867 the temperature alternated in January, February, and March, when a bold and continuous rise took place month by month to August at most places, and then a continuous decline to December. Comparing the curve at Culloden with that at Guernsey, the evenness of the latter contrasts with the want of evenness of the former, which is wavy in form till August. In the year 1868 the temperature increased from January to July, the maximum being attained at all stations in this month; it then declined, somewhat reluctantly, at extreme south stations till September, but continuously at northern stations to November, when a rise took place at all stations, greater in amount at southern than at northern; and it is remarkable, as a contrast with that of the preceding year, that the curve for Culloden is almost smooth and continuous, whilst that at Guernsey is wavy in form, being the reverse of that in 1867. The monthly mean temperature was lowest in January 1868, a second minimum being in November at all places. Besides the extraordinary heat, the year 1868 was remarkable for the fewness of the thunder- and hail-storms usually the accompaniment of great heat, also for the heavy falls of rain in the month of January and December, and very small amounts in all the other parts of the year, excepting April, as well as for the unusual prevalence of the wind from the west; the annual means of the several elements, at the several stations between Guernsey and Culloden, for both years, are shown in the following Tables:—

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TABLE I. Mean Annual Value of

Names of Stations.	Elevation in feet above the sea-level.	Latitude.	Barometer.		Thermometer.					
			Mean Reading at the Height of Station.	Mean Monthly Range.	Mean of the Highest Monthly Readings.	Mean of the Lowest Monthly Readings.	Mean Monthly Range of Temperature.	Mean of all the Highest Daily Readings.	Mean of all the Lowest Daily Readings.	Mean Daily Range.
	ft.	° ′	ins.	ins.	°	°	°	°	°	°
Guernsey	204	49 20N.	29·780	1·028	64·9	39·7	25·2	56·0	47·0	9·0
Helston	106	50 7	29·898	1·092	67·3	39·0	28·3	59·2	46·7	12·5
Truro	43	50 17	29·918	1·097	66·9	31·6	35·3	58·6	45·3	13·3
Sidmouth	30	50 41	.....	1·134	65·8	33·7	32·1	57·3	43·4	13·9
Eastbourne	11	50 44	29·979	0·998	66·9	32·4	34·5	56·7	43·5	13·2
Osborne	172	50 45	29·798	1·073	70·6	32·9	37·7	58·7	42·4	16·3
Bournemouth	125	.....	29·877	1·100	65·8	33·1	32·7	56·9	43·2	13·7
Worthing	25	50 47	29·957	0·974	64·9	34·8	30·1	56·1	44·1	12·0
Wilton	150	51 4	29·789	1·068	68·8	26·8	42·0	58·0	38·8	19·2
Barnstaple	43	51 5	29·924	1·112	68·1	33·2	34·9	57·7	44·5	13·2
Aldershot Camp	325	51 15	29·567	1·027	68·9	29·7	39·2	57·2	41·1	16·1
Bath	86	51 23	29·873	1·146	67·4	30·4	37·0	56·1	42·7	13·4
Marlborough College	456	51 25	29·496	1·116	68·7	26·6	42·1	55·3	39·4	15·9
Clifton	228	51 28	29·717	1·174	67·8	33·0	34·8	56·1	43·1	13·0
Royal Observatory	159	51 29	29·797	1·132	69·7	30·8	38·9	57·3	41·8	15·5
Streatly Vicarage	152	51 30	.....	.....	.....	.....	.....	.....	.....	.....
Camden Town	100	51 32	29·843	1·097	69·2	30·7	38·5	57·8	42·7	15·1
Oxford	210	51 45	29·714	1·132	67·4	29·6	37·8	55·9	42·1	13·8
Gloucester	100	51 55	29·870	1·174	70·2	31·3	38·9	58·3	42·7	15·6
Royston	269	52 2	29·694	1·102	70·3	30·4	39·9	57·4	41·5	15·9
Cardington	100	52 7	39·858	1·106	68·8	28·3	40·5	56·8	40·9	15·9
Wisbech	14	52 41	29·920	1·105	69·2	30·1	39·1	57·2	41·7	15·5
Llandudno	100	.....	.....	.....	68·1	36·5	31·6	56·2	44·3	11·9
Grantham	181	52 55	.....	.....	.....	.....	.....	.....	.....	.....
Derby	174	52 55	29·751	1·124	67·3	31·4	35·9	55·9	41·7	14·2
Holkham	39	52 57	29·889	1·127	66·7	29·6	37·1	55·1	42·1	13·0
Boston	20	52 59	29·893	1·220	68·1	31·3	36·8	55·9	41·9	14·0
Hawarden	270	53 11	29·646	1·222	.....	35·2	.....	.....	44·1	.....
Kingsley Parsonage	194	53 16	29·715	1·208	68·0	29·3	38·7	56·1	41·2	14·9
Liverpool	212	53 24	.....	1·172	66·8	35·2	31·6	54·8	43·3	11·5
Manchester	123	53 29	29·796	1·213	69·0	30·7	38·3	55·9	40·8	15·1
Eccles	145	53 29	29·779	1·165	67·6	30·1	37·5	54·8	41·2	13·6
Wakefield	115	53 41	29·811	1·222	68·7	27·7	41·0	57·1	35·2	21·9
Halifax	660	.....	28·951	1·179	62·5	31·5	31·0	49·9	41·1	8·8
Leeds	138	53 48	.....	1·172	69·1	32·8	36·3	56·9	41·7	15·2
Stonyhurst	381	53 51	29·489	1·218	65·6	29·9	35·7	54·1	41·2	12·9
Otley	205	53 54	29·658	1·196	63·0	34·1	28·9	52·4	43·2	9·2
York	50	53 58	29·847	1·207	64·3	31·2	33·1	53·3	.....	.....
Ripon	146	54 8	29·760	1·208	67·2	27·6	39·6	55·1	39·7	15·4
Cockermouth	148	54 39	29·747	1·274	65·3	29·7	35·6	54·5	43·2	11·3
Allenheads	1360	54 49	28·335	1·190	58·6	26·5	32·1	49·8	37·8	12·0
Silloth	28	54 52	29·850	1·321	66·5	30·9	35·6	55·7	42·2	13·5
Carlisle	114	54 53	29·820	1·305	66·3	28·0	38·3	54·2	40·3	13·9
North Shields	124	55 0	29·830	1·239	62·0	32·6	29·4	51·7	41·6	10·1
Miltown (Ireland)	200	54 23	29·673	1·305	64·3	28·8	35·5	54·8	40·9	13·9
Culloden (Scotland)	104	57 31	29·711	1·415	59·6	33·1	26·6	50·4	41·5	8·9

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Meteorological Elements in the Year 1867.

Mean Temperature of the Air.	Mean Temperature of the Dew-point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight of Vapour required for Saturation.	Mean Degree of Humidity of the Air (Saturation = 100).	Mean Weight of a cubic foot of Air.	Wind.					Mean Amount of Cloud (0–10).	Rain.	
							Mean estimated Strength.	Relative Proportion of					Number of Days it fell.	Amount collected.
								N.	E.	S.	W.			
°	°	in.	grs.	gr.		grs.								ins.
50·3	45·6	·314	3·6	0·7	84	541	1·5	99	69	84	113	5·2	169	37·1
51·7	48·1	·343	3·9	0·6	87	541	2·2	80	95	73	117	6·5	181	38·3
50·3	45·0	·306	3·5	0·8	82	543	2·2	108	77	67	113	7·0	200	.....
49·3	44·0	·299	3·4	0·7	83	545	1·8	116	64	78	107	3·7	177	36·5
49·5	44·3	·305	3·4	0·7	83	545	0·6	82	63	80	140	.....	185	29·6
49·4	46·3	·327	3·7	0·5	89	542	0·4	90	63	92	120	6·3	134	27·7
.....	.....	.....	.....	.....	.....	.....	.....	106	34	82	143	.....	133	27·4
49·4	45·4	·316	3·5	0·7	86	545	0·8	95	55	92	123	4·5	141	23·9
48·0	43·5	·297	3·4	0·6	85	544	1·5	112	61	100	92	6·0	180	31·6
.....	.....	.....	.....	.....	.....	.....	.....	74	71	98	122	3·9	.....	.....
48·5	43·5	·293	3·4	0·8	84	539	1·5	89	59	81	136	7·3	178	25·9
48·8	43·5	·290	3·3	0·8	82	544	1·6	85	73	67	140	7·2	181	30·3
47·0	.....	.....	.....	.....	.....	.....	.....	99	79	70	117	6·7	195	32·9
48·6	43·5	·293	3·3	0·8	83	542	0·6	86	68	83	128	6·3	216	33·6
48·6	43·0	·289	3·3	0·8	81	543	0·5	80	63	105	117	7·0	163	28·6
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	140	26·6
49·6	43·7	·293	3·3	0·9	81	543	.....	.....	.....	.....	.....	4·5	152	26·2
48·8	44·3	·300	3·4	0·7	84	541	1·2	94	51	91	129	7·4	161	27·2
49·7	42·7	·285	3·3	1·2	78	543	.....	90	81	70	124	6·2	131	24·0
48·1	43·3	·290	3·3	0·7	84	541	.....	85	37	95	148	6·6	182	24·9
48·4	42·8	·286	3·2	0·8	81	544	1·0	90	65	77	133	6·8	.....	23·2
48·7	45·1	·314	3·6	0·6	87	545	0·4	77	66	90	132	6·6	155	26·0
49·6	43·7	·293	3·3	0·8	81	542	0·5	65	79	18	203	6·5	168	32·0
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	189	25·0
47·4	43·3	·290	3·3	0·6	85	543	.....	78	71	61	155	.....	168	29·5
47·7	42·8	·285	3·2	0·7	83	545	1·7	107	39	128	94	6·9	.....	25·7
47·8	44·0	·300	3·4	0·6	86	545	1·5	88	62	71	144	6·1	204	25·0
48·1	43·3	·290	3·3	0·7	83	541	2·1	95	50	86	134	6·9	170	27·5
47·8	42·6	·285	3·2	0·7	84	542	0·7	65	69	108	123	6·9	180	29·1
47·9	44·5	·295	3·3	0·7	86	543	.....	.....	.....	.....	.....	6·5	.....	.....
47·4	41·7	·274	3·1	0·7	81	544	.....	53	76	148	88	7·0	188	34·6
47·4	42·1	·276	3·2	0·8	83	544	0·2	101	72	59	132	6·6	210	35·6
48·1	40·9	·262	3·0	1·0	77	544	1·4	70	58	78	159	6·3	178	27·3
45·0	40·6	·258	2·9	0·6	85	536	0·8	80	75	73	137	7·5	.....	24·0
48·6	42·9	·288	3·3	0·8	81	540	1·6	106	53	75	131	7·0	163	21·0
46·7	41·9	·276	3·2	0·7	84	539	0·7	80	69	80	136	7·8	222	43·2
46·5	41·5	.270	3·1	0·6	84	543	1·4	80	54	53	178	6·8	.....	23·5
46·8	44·4	·305	3·5	0·4	91	545	.....	.....	.....	.....	.....	.....	156	25·2
46·8	40·2	·257	2·9	0·9	78	544	1·0	115	65	53	132	5·8	149	25·8
47·5	42·1	·276	3·2	0·7	83	543	0·5	56	62	79	168	5·0	185	38·3
42·3	37·8	·239	2·7	0·5	84	525	1·7	63	55	96	151	7·0	267	45·3
40·6	42·7	·288	3·2	0·7	82	544	1·2	40	97	64	164	5·8	171	26·4
46·5	43·0	·290	3·3	0·5	88	545	0·2	47	81	94	143	8·3	184	23·8
45·4	41·2	·267	3·1	0·5	85	547	1·5	96	61	79	129	6·1	188	23·5
47·1	41·5	·269	3·2	0·7	81	542	2·3	77	57	127	105	5·4	212	32·1
45·1	41·7	·272	3·1	0·5	87	545	0·3	58	84	86	137	6·2	206	26·3

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TABLE II. Mean Annual Value of

Names of Stations.	Elevation in feet above the sea-level.	Latitude.	Barometer.		Thermometer.					
			Mean Reading at the Height of Station.	Mean Monthly Range.	Mean of the Highest Monthly Readings.	Mean of the Lowest Monthly Readings.	Mean Monthly Range of Temperature.	Mean of all the Highest Daily Readings.	Mean of all the Lowest Daily Readings.	Mean Daily Range.
	ft.	° ′	ins.	ins.	°	°	°	°	°	°
Guernsey	204	49 20N.	29·776	1·041	65·3	41·5	23·8	57·3	48·4	8·9
Helston	106	50 7	29·903	1·157	70·0	39·1	30·9	61·0	48·7	12·3
Truro	43	50 17	29·941	1·148	68·7	33·8	34·9	60·4	46·5	13·9
Sidmouth	30	50 41	.....	1·143	66·3	36·3	30·0	59·3	45·1	14·2
Eastbourne	11	50 44	29·975	1·053	69·3	35·9	33·4	59·5	45·5	14·0
Osborne	172	50 45	29·803	1·110	73·5	34·6	38·9	62·6	43·4	19·2
Bournemouth	128	.....	29·850	1·152	67·8	35·1	32·7	59·1	45·2	13·9
Worthing	25	50 47	29·940	.....	66·7	36·4	30·3	58·3	46·3	12·0
Wilton	150	51 4	29·775	1·161	73·6	28·5	45·1	62·3	40·0	22·3
Barnstaple	43	51 5	29·917	1·191	69·7	36·5	33·2	60·2	46·3	13·9
Tunbridge Wells	410	51 8	29·531	1·109	71·5	34·5	37·0	59·4	44·1	15·3
Aldershot Camp	325	51 15	29·566	1·115	72·2	32·9	39·3	60·8	42·7	18·1
Weybridge Heath	150	51 21	29·836	1·062	72·7	31·4	41·3	60·7	42·6	18·1
Bath	86	51 23	29·869	1·210	70·5	33·3	37·2	59·6	44·3	15·3
Strathfield Turgiss	209	51 24	29·776	1·188	73·5	30·5	43·0	61·4	42·5	18·9
Marlborough College	456	51 25	29·488	1·193	71·4	29·0	42·4	58·3	41·1	17·2
Royal Observatory	159	51 29	29·706	1·190	73·1	34·3	38·8	61·1	43·5	17·6
Streatly Vicarage	152	51 30	29·829	1·160	70·1	31·2	38·9	59·5	40·5	19·0
London (21 Dorset Sq.)	146	51 31	29·821	1·171	73·3	35·1	38·2	61·4	45·8	15·6
Camden Town	100	51 32	29·830	1·155	73·0	34·6	38·4	61·1	43·9	17·2
Oxford	210	51 45	29·721	1·177	70·7	32·1	38·6	59·6	43·5	16·1
Gloucester	100	51 55	29·866	1·271	71·7	33·2	38·5	60·8	44·6	16·2
Royston	269	52 2	29·683	1·202	73·8	32·3	41·5	61·1	43·1	18·0
Cardington	100	52 7	29·849	1·224	72·9	31·9	41·0	60·5	42·6	17·9
Lampeter	420	52 7	29·538	1·283	71·5	28·9	42·6	60·2	41·2	19·0
Norwich	50	52 30	29·896	1·192	70·0	36·1	33·9	58·3	44·3	14·0
Wisbeach	14	52 41	29·916	1·206	72·5	34·0	38·5	60·3	43·5	16·8
Llandudno	100	.....	29·792	1·353	71·1	37·1	34·0	58·6	45·7	12·9
Grantham	181	52 55	29·735	1·243	70·8	34·7	36·1	58·1	44·8	13·3
Derby	174	52 55	29·708	1·259	70·9	33·7	37·2	59·1	43·7	15·4
Holkham	39	52 57	29·892	1·216	70·1	33·1	37·0	57·9	43·9	14·0
Nottingham	239	52 57	29·657	1·214	73·2	31·2	42·0	60·5	41·7	18·8
Boston	20	52 59	29·882	1·349	72·2	34·7	37·5	59·2	44·3	14·9
Hawarden	270	53 11	29·619	1·353	68·9	37·4	31·5	57·8	46·7	11·1
Eccles	145	53 29	29·756	1·274	71·5	31·8	39·7	58·3	42·8	15·5
Halifax	660	.....	29·186	1·360	66·9	31·5	35·4	54·0	41·8	12·2
Hull	12	53 45	29·897	1·381	69·4	29·8	39·6	57·2	40·9	16·3
Leeds	138	53 48	29·603	1·350	73·0	33·9	39·1	60·1	43·0	17·1
Stonyhurst	381	53 51	29·475	1·333	68·9	32·1	36·8	57·2	43·0	14·2
Otley	205	53 54	29·646	1·355	66·4	35·6	30·8	55·7	44·8	10·9
York	50	53 58	29·811	1·345	68·8	32·9	35·9	56·5	43·4	13·1
Ripon	146	54 8	29·744	1·396	71·3	29·9	41·4	58·7	41·2	17·5

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Meteorological Elements in the Year 1868.

Mean Temperature of the Air.	Mean Temperature of the Dew-point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight of Vapour required for Saturation.	Mean Degree of Humidity of the Air (Saturation = 100).	Mean Weight of a cubic foot of Air.	Wind.					Mean amount of Cloud (0–10).	Rain.	
							Mean estimated Strength.	Relative Proportion of					Number of Days it fell.	Amount collected.
								N.	E.	S.	W.			
°	°	in.	grs.	gr.		grs.								ins.
51·6	47·2	·331	3·8	0·6	86	539	1·5	94	68	90	114	4·6	177	34·7
53·6	47·9	·340	3·8	0·9	82	539	2·4	77	73	70	146	5·8	176	36·5
52·6	48·6	·353	4·0	0·7	86	541	2·1	110	68	66	122	6·5	193	45·0
51·2	46·0	·318	3·6	0·8	83	543	1·4	90	49	70	157	3·2	173	31·8
52·5	46·4	·326	3·7	1·0	80	542	0·7	70	68	104	124	.....	158	29·1
52·1	48·2	·348	3·9	0·7	87	538	1·1	83	71	92	120	5·5	139	32·8
51·4	45·2	·309	3·5	0·9	80	541	.....	.....	.....	.....	.....	4·4	164	35·4
51·7	47·3	·342	3·9	0·8	85	543	1·4	77	64	95	130	4·2	133	24·2
50·5	45·4	·313	3·6	0·8	83	540	1·5	93	63	87	123	4·7	168	38·4
52·8	45·9	·318	3·6	1·1	78	540	1·2	54	60	119	133	3·2	193	39·9
51·0	44·1	·299	3·4	1·1	78	536	1·2	80	63	109	114	5·5	150	32·8
51·2	44·8	·307	3·5	1·0	79	536	1·5	71	62	99	134	6·8	147	30·9
50·7	44·2	·300	3·4	1·0	79	541	1·0	71	74	116	105	5·1	148	26·0
51·3	45·1	·310	3·5	0·9	80	541	1·8	63	67	82	154	6·5	154	30·5
51·1	44·4	·308	3·5	1·0	82	540	5·1	103	56	84	123	5·9	130	31·9
49·1	.....	.....	.....	.....	.....	.....	.....	92	79	70	125	6·8	159	35·4
51·5	44·8	·306	3·5	1·1	78	540	0·6	73	60	110	123	6·2	144	25·4
50·6	44·0	·291	3·3	1·1	78	542	2·2	81	61	97	127	5·7	152	29·0
52·7	44·9	·305	3·4	1·3	76	540	.....	73	63	95	135	.....	160	22·2
52·0	44·8	·305	3·4	1·2	77	540	.....	131	50	91	94	6·1	143	23·4
51·5	45·2	·311	3·5	1·0	80	538	1·3	79	49	107	131	6·8	175	26·7
52·6	46·0	·323	3·6	1·1	79	540	0·9	77	77	58	154	5·3	141	26·6
51·2	44·0	·297	3·4	1·1	88	538	.....	87	42	98	139	6·0	172	21·6
51·5	43·5	·289	3·3	1·3	76	541	1·0	80	64	91	131	6·0	124	22·0
49·9	43·8	·292	3·3	0·9	80	537	0·6	57	87	107	115	6·6	175	48·6
50·9	43·7	·291	3·3	1·1	78	542	.....	78	54	125	109	.....	118	23·2
51·5	45·1	·308	3·5	1·1	80	542	0·4	75	70	106	115	5·8	123	22·9
51·6	44·8	·304	3·4	1·0	79	540	0·7	42	77	25	222	6·1	163	29·5
50·6	44·0	·295	3·3	1·0	79	540	0·4	71	56	101	138	6·6	166	21·8
51·1	42·0	·274	3·2	1·3	73	539	.....	71	62	89	144	.....	178	26·1
50·4	43·2	·287	3·2	1·1	77	543	1·7	108	52	128	78	6·5	143	23·4
50·3	44·8	·307	3·5	0·8	82	539	0·4	79	59	90	138	.....	172	25·4
51·3	44·6	·301	3·4	1·1	79	541	1·4	70	68	89	139	5·8	165	24·1
50·8	44·5	·302	3·4	0·9	80	537	2·3	95	39	97	135	5·9	175	27·8
49·9	43·1	·284	3·2	1·0	78	541	0·4	78	63	85	140	6·4	208	32·9
47·2	43·2	·288	3·3	0·6	86	533	0·6	67	80	86	133	6·8	.....	.....
48·8	43·3	·290	3·3	0·8	82	545	.....	.....	.....	.....	.....	.....	180	26·1
51·4	45·5	·311	3·5	0·9	82	536	1·9	99	53	85	129	6·0	170	23·1
49·0	43·8	·294	3·3	0·8	83	536	.....	56	68	86	156	6·8	247	47·2
49·3	42·8	·283	3·2	0·9	79	539	1·6	53	83	40	190	7·0	148	31·0
49·4	45·1	·309	3·5	0·7	86	542	.....	40	81	138	107	.....	166	25·8
49·4	41·6	·268	3·1	1·1	75	541	0·9	90	63	56	157	5·7	163	30·7

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TABLE II. Mean Annual Value of Meteorological

Names of Stations.	Elevation in feet above the sea-level.	Latitude.	Barometer.		Thermometer.					
			Mean Reading at the Height of Station.	Mean Monthly Range.	Mean of the Highest Monthly Readings.	Mean of the Lowest Monthly Readings.	Mean Monthly Range of Temperature.	Mean of all the Highest Daily Readings.	Mean of all the Lowest Daily Readings.	Mean Daily Range.
	ft.	° ′	ins.	ins.	°	°	°	°	°	°
Cockermouth.....	148	54 39	29·713	1·472	67·8	31·8	36·0	57·0	44·1	12·9
Allenheads.....	1360	54 49	28·392	1·360	62·6	28·2	34·4	52·0	39·6	12·4
Silloth	28	54 42	29·818	1·442	68·7	32·1	36·6	57·5	43·9	13·6
Carlisle	114	54 53	29·755	1·465	68·8	29·7	39·1	57·4	42·0	15·4
Bywell	87	54 57	29·750	1·419	70·7	.....	.....	58·6	42·8	15·8
North Shields	124	55 0	29·798	1·416	66·9	34·2	32·7	55·2	43·3	11·9
Miltown (Ireland) ...	200	54 23	29·626	1·453	66·7	30·7	36·0	56·5	42·2	14·3
Culloden (Scotland)...	104	57 31	29·642	1·550	64·0	35·3	28·7	52·9	43·5	9·4

By taking the means of the numbers between each

TABLE III. Mean Annual Value of Meteorological Elements

	Parallels of Latitude, &c.	Mean height.								
1867.	Guernsey.....	204	29·780	1·028	64·9	39·7	25·2	56·0	47·0	9·0
	Between the Latitudes									
	50° and 51°	64	29·904	1·067	66·9	33·9	33·0	57·6	44·1	13·5
	51° and 52°	186	29·710	1·118	68·6	30·2	38·4	57·0	41·9	15·1
	52° and 53°	103	29·834	1·131	68·4	31·1	37·3	56·4	42·0	14·4
	53° and 54°	238	29·632	1·198	66·5	31·2	35·3	54·7	41·0	13·7
	54° and 55°	359	29·502	1·260	64·8	28·5	36·3	53·9	40·6	13·3
	North Shields	124	29·830	1·239	62·0	32·6	29·4	51·7	41·6	10·1
	Miltown (Ireland)	200	29·673	1·305	64·3	28·8	35·5	54·8	40·9	13·9
	Culloden (Scotland) ...	104	29·711	1·415	59·6	33·1	26·5	50·4	41·5	8·9
1868.	Guernsey.....	204	29·776	1·041	65·3	41·5	23·8	57·3	48·4	8·9
	Between the Latitudes									
	50° and 51°	81	29·902	1·127	68·9	35·9	33·0	60·0	45·8	14·2
	51° and 52°	193	29·752	1·168	71·9	32·7	39·2	60·4	43·2	17·2
	52° and 53°	152	29·777	1·249	71·7	33·4	38·3	59·4	43·5	15·9
	53° and 54°	233	29·624	1·344	69·2	33·1	36·1	57·1	43·3	13·8
	54° and 55°	314	29·529	1·426	67·8	30·3	37·5	56·9	42·3	14·6
	North Shields	124	29·798	1·416	66·9	34·2	32·7	55·2	43·3	11·9
	Miltown (Ireland)	200	29·626	1·453	66·7	30·7	36·0	56·5	42·2	14·3
	Culloden (Scotland) ...	104	29·642	1·550	64·0	35·3	28·7	52·9	43·5	9·4
	Between the Latitudes									
1867.	49° and 58°	176	29·731	1·196	65·1	32·1	33·0	54·7	42·3	12·4
1868.	49° and 58°	178	29·714	1·308	68·0	34·1	33·9	57·3	43·9	13·4

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Elements in the Year 1868 (*continued*).

Mean Temperature of the Air.	Mean Temperature of the Dew-point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight of Vapour required for Saturation.	Mean Degree of Humidity of the Air (Saturation = 100).	Mean Weight of a cubic foot of Air.	Wind.					Mean amount of Cloud (0–10).	Rain.	
							Mean estimated Strength.	Relative Proportion of					Number of Days it fell.	Amount collected.
								N.	E.	S.	W.			
°	°	in.	grs.	gr.		grs.								ins.
49·7	42·9	·282	3·2	1·0	79	541	0·6	45	61	94	166	6·5	181	50·0
44·8	39·7	·252	2·9	0·6	83	521	1·9	60	55	104	147	7·0	266	56·4
49·7	44·2	·297	3·3	0·8	82	542	1·3	31	91	83	161	5·6	164	37·7
49·1	45·1	·309	3·5	0·6	87	542	0·6	57	61	106	142	7·2	169	28·8
49·4	41·4	·266	3·1	1·1	75	541	1·3	.....	.....	.....	.....	5·2	199	27·7
48·3	41·6	·268	3·1	0·9	78	543	1·7	90	55	84	137	5·7	188	23·2
48·6	42·9	·280	3·2	0·8	81	540	2·3	56	59	157	94	5·1	193	27·8
47·8	42·5	·280	3·2	0·7	84	541	0·4	28	42	133	163	6·2	185	31·5

parallel of 1° of latitude, the next Table is formed.

in the Years 1867 and 1868 for different Parallels of Latitude.

50·3	45·6	·314	3·6	0·7	84	541	1·5	99	69	84	113	5·2	169	37·1
49·9	45·5	·316	3·6	0·7	85	543	1·3	97	64	81	123	5·6	164	30·6
48·6	43·5	·293	3·3	0·8	82	542	1·1	90	67	85	123	6·2	170	28·7
48·2	43·6	·294	3·3	0·7	84	544	0·7	84	60	77	144	6·6	178	26·4
47·3	42·4	·280	3·2	0·7	84	542	1·1	81	64	85	135	6·9	183	29·1
44·7	41·2	·270	3·1	0·7	83	540	0·9	64	72	77	152	6·4	191	31·9
45·4	41·2	·267	3·1	0·5	85	547	1·5	96	61	79	129	6·1	188	23·5
47·1	41·5	·269	3·2	0·7	81	542	2·3	77	57	126	105	5·4	212	32·1
45·1	41·7	·272	3·1	0·5	87	545	0·3	58	84	86	137	6·2	206	26·3
51·6	47·2	·331	3·8	0·6	86	539	1·5	94	68	90	114	4·6	177	34·7
52·2	47·1	·334	3·4	0·5	83	540	1·3	85	65	83	133	4·9	162	33·5
51·3	44·9	·307	3·5	1·1	79	540	1·7	81	63	95	127	5·7	155	29·9
50·9	43·6	·295	3·3	1·1	79	537	0·8	74	63	95	134	6·2	155	26·2
49·5	43·9	·295	3·5	0·8	82	539	1·5	70	67	88	141	6·5	185	30·6
48·7	42·5	·279	3·2	0·9	80	538	1·1	57	66	89	154	6·2	190	38·5
48·3	41·6	·268	3·1	0·9	78	543	1·7	90	55	84	137	5·7	188	23·2
48·6	42·9	·280	3·2	0·8	81	540	2·3	56	59	157	94	5·1	193	27·8
47·8	42·5	·280	3·2	0·7	84	541	0·4	28	42	133	163	6·2	185	31·5
47·4	42·9	·286	3·3	0·9	84	543	1·2	83	66	87	129	6·1	185	29·5
49·9	44·0	·295	3·4	0·8	81	540	1·4	71	61	101	233	5·7	177	30·7

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By comparing these results together year by year (see Table III.) it is found that there is an almost uniform difference between the two years in every element in each parallel of latitude in respect to temperature, both in highest and lowest and in the mean, and also in rain, excepting in one parallel, viz. that between the latitudes 52° and 53°, where the amounts in the two years are very nearly identical. This excess is shown from Guernsey to Culloden in a rather increasing degree proceeding northwards, thus extending over nearly 9° of latitude, the excess being rather less at southern places than at northern; the mean temperature at Culloden for the year 1867 was below that at Guernsey by 5°·2, and in the year 1868 by 3°·8 only. The uniformity of the results in the year 1868 (the more remarkable year by far of the two) over large tracts of country gives a value to the discussion of observations made at any one place more in detail, as daily results of observation, than would have been the case had not this uniformity prevailed. I therefore have used those daily observations which have been made at the Royal Observatory, Greenwich, under my own superintendence, and think it likely that the leading particulars thus shown will be applicable generally over the country, so far as excess or deficiency above or below the average is applicable to the character of the year.

The following Tables show the maximum, minimum, and adopted mean temperature of every day in the year 1868.

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TABLE IV. Showing the Maximum Temperature of every Day in the Year 1868.

Day of Month.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
	°	°	°	°	°	°	°	°	°	°	°	°
1.	31·2	55·0	47·7	55·0	66·6	73·9	73·6	84·0	78·7	59·9	57·1	44·9
2.	34·4	49·7	53·7	56·8	70·4	71·7	77·8	84·0	78·0	61·4	55·1	49·7
3.	30·0	50·9	55·1	61·1	82·3	73·9	84·3	81·5	83·5	50·0	53·2	51·9
4.	31·8	47·9	56·4	67·8	65·3	61·3	67·8	86·8	85·2	60·2	53·9	55·0
5.	32·7	48·2	57·6	66·6	58·1	71·4	73·4	90·5	82·5	64·0	46·7	57·4
6.	35·9	49·8	51·0	64·8	55·8	78·4	73·2	78·9	86·5	60·3	42·9	57·8
7.	32·7	46·8	54·0	64·9	65·1	72·9	76·8	83·4	92·1	59·9	43·1	53·0
8.	34·0	45·8	49·7	56·5	74·2	66·3	83·6	79·9	69·6	62·0	43·7	54·0
9.	31·2	41·4	50·6	49·2	73·2	69·5	85·0	79·7	71·1	61·5	46·3	50·2
10.	32·8	51·9	54·3	52·5	68·0	77·0	82·8	82·7	74·1	63·0	46·9	51·9
11.	32·7	49·7	50·7	48·7	65·8	74·4	84·1	73·1	76·1	62·7	47·4	55·0
12.	43·5	43·6	56·1	44·2	71·9	76·6	80·1	75·9	74·2	66·6	46·4	43·7
13.	49·1	50·0	56·3	52·8	71·6	85·1	84·7	69·2	66·0	58·4	45·4	49·4
14.	51·9	47·7	51·7	57·8	73·2	85·5	85·7	74·4	64·6	56·1	46·2	52·8
15.	51·4	45·7	55·8	62·5	77·2	78·9	88·0	79·1	64·5	60·1	44·8	54·8
16.	49·7	47·2	51·8	61·1	70·0	78·8	92·0	71·0	69·3	60·0	43·3	51·0
17.	51·9	51·3	54·1	58·7	70·6	83·2	84·0	68·8	68·9	57·3	45·6	50·7
18.	49·7	47·9	52·7	54·3	71·7	75·1	87·8	74·8	66·5	47·7	46·0	53·1
19.	47·7	45·9	52·6	57·8	87·0	71·2	82·8	70·4	64·3	46·7	46·6	46·5
20.	42·4	49·7	49·1	57·1	75·4	88·0	90·0	63·6	68·0	47·7	43·4	45·9
21.	41·1	55·2	57·8	63·8	72·4	84·0	92·2	73·2	74·4	52·2	49·4	54·3
22.	42·9	52·2	53·1	61·2	66·1	69·2	96·6	68·3	69·5	54·3	53·0	53·9
23.	36·6	43·1	51·2	61·6	62·9	72·4	79·7	67·5	66·5	53·5	53·0	46·9
24.	38·1	56·2	45·2	59·5	61·6	75·8	73·1	68·3	69·7	59·6	43·7	49·5
25.	47·4	61·7	47·7	55·2	69·8	76·1	76·4	70·4	63·2	55·9	46·3	46·4
26.	43·1	55·9	54·6	62·9	69·8	79·7	84·1	69·8	69·0	54·8	48·7	48·1
27.	45·2	49·7	58·5	62·4	76·1	88·0	89·3	75·1	64·1	49·9	42·3	53·9
28.	49·7	56·2	51·0	54·8	74·9	77·6	90·1	67·8	64·0	51·8	41·7	50·9
29.	44·2	51·0	51·8	64·6	74·3	75·2	64·7	68·5	65·5	52·7	43·1	48·9
30.	47·3	...	51·8	68·9	73·2	76·9	81·4	73·0	62·3	53·0	42·8	40·2
31.	51·4	...	57·2	...	71·3	...	78·0	75·4	...	59·3	...	43·4
Sums ...	43·7	287·3	90·9	265·1	15·8	188·0	63·1	159·0	51·9	212·5	208·0	15·1
Means...	41·4	49·9	52·9	58·8	70·5	76·3	82·0	75·1	71·7	56·9	46·9	50·5

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TABLE V. Showing the Minimum Temperature of every Day in the Year 1868.

Day of Month.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
	°	°	°	°	°	°	°	°	°	°	°	°
1.	25·5	43·0	34·6	39·2	49·3	44·7	53·4	49·4	49·7	48·6	52·3	39·6
2.	27·9	38·9	40·3	39·3	40·6	51·5	54·7	52·8	50·3	42·9	39·4	42·0
3.	22·8	34·0	43·0	38·6	43·7	47·5	58·4	60·4	54·1	40·8	42·0	44·1
4.	26·7	31·1	46·4	33·5	43·0	47·7	51·0	61·3	53·1	39·3	44·7	45·0
5.	26·8	39·7	41·0	38·2	41·4	49·4	48·2	60·7	54·9	47·8	30·4	51·3
6.	29·2	34·6	37·4	42·3	39·4	47·9	52·5	62·9	54·4	48·7	26·1	49·5
7.	25·0	34·1	35·3	42·7	33·9	53·8	51·6	58·0	54·4	41·3	27·2	46·7
8.	30·7	32·0	35·4	36·0	35·9	45·6	53·8	56·1	56·3	39·3	28·4	47·1
9.	29·2	26·7	32·5	34·7	49·5	45·3	57·6	53·4	52·8	43·0	29·5	38·6
10.	28·7	37·1	36·9	33·2	46·8	46·6	51·3	57·5	48·5	42·6	33·4	41·0
11.	28·9	37·8	35·3	32·9	43·2	46·6	53·2	58·0	43·6	35·4	37·9	41·6
12.	33·6	30·7	39·0	28·9	42·1	54·9	56·9	53·9	54·2	41·0	40·4	32·7
13.	41·8	33·7	42·8	34·5	42·9	50·8	55·4	54·7	46·5	44·7	40·9	39·0
14.	38·1	41·1	45·0	36·0	48·5	55·1	52·7	52·0	48·7	39·0	38·0	46·1
15.	39·2	33·8	34·7	31·5	46·8	51·6	57·6	54·9	51·7	37·5	31·7	49·0
16.	38·1	29·4	37·2	44·3	53·0	52·3	59·5	60·2	48·0	43·6	30·9	44·1
17.	43·7	33·2	36·8	46·0	50·2	57·1	63·6	60·3	51·2	39·6	39·6	43·1
18.	40·7	35·5	34·9	38·0	45·6	53·4	61·8	59·0	50·5	37·8	41·1	46·5
19.	38·8	40·0	32·3	41·7	53·0	49·2	62·7	60·0	48·2	30·0	37·1	36·7
20.	29·5	32·2	32·1	44·1	48·0	53·8	52·4	58·7	56·1	29·3	29·0	35·1
21.	29·5	41·4	44·4	44·8	42·4	56·5	62·7	54·5	47·1	37·0	29·7	42·2
22.	35·6	39·6	45·7	49·3	51·6	55·8	62·4	51·7	53·0	34·5	43·2	42·4
23.	32·0	35·7	35·0	44·1	47·5	48·4	54·0	51·9	50·3	39·6	39·0	37·9
24.	26·3	38·9	31·9	45·1	45·1	48·5	50·9	49·0	48·6	39·0	34·2	39·5
25.	34·1	43·4	29·9	43·9	49·0	55·2	51·2	49·3	46·7	44·9	32·0	35·9
26.	29·8	42·1	33·3	44·8	47·0	50·9	56·4	47·8	51·0	39·6	38·3	37·7
27.	29·8	44·4	41·9	41·3	45·4	51·0	59·3	50·2	55·4	36·7	39·3	43·3
28.	44·1	41·3	38·8	38·7	46·0	55·0	61·1	48·0	52·4	34·8	37·8	38·2
29.	34·4	41·9	31·1	49·7	51·8	49·5	54·4	52·4	52·4	40·0	30·9	34·0
30.	34·6	...	28·1	47·2	54·6	47·8	50·2	50·1	48·7	39·0	38·6	32·6
31.	42·7	...	29·2	...	52·9	...	55·8	56·1	...	46·4	...	31·5
Sums ...	87·8	197·3	212·2	4·5	190·1	23·4	176·7	155·2	33·8	3·7	1083·0	34·0
Means...	32·8	36·8	36·8	40·1	46·1	50·8	55·7	55·0	51·1	40·2	36·1	41·1

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TABLE VI. Showing the Mean Temperature of every Day in the Year 1868.

Day of Month.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
	°	°	°	°	°	°	°	°	°	°	°	°
1.	28·9	48·0	40·1	47·0	55·5	58·8	59·6	66·4	63·4	52·8	54·5	42·1
2.	29·8	43·3	47·4	46·8	55·5	57·9	64·7	68·9	63·4	50·9	47·4	46·4
3.	27·1	40·4	48·0	47·6	63·4	58·1	65·6	70·3	67·6	45·6	49·0	48·9
4.	27·9	40·3	50·0	50·5	51·2	54·4	56·2	73·2	69·4	50·2	49·8	51·6
5.	30·8	44·3	48·3	51·4	48·2	58·9	59·4	74·2	68·1	55·0	38·4	53·7
6.	32·1	40·9	43·3	52·3	46·2	62·7	62·1	67·6	69·4	54·9	33·5	53·9
7.	28·7	41·1	43·9	53·1	49·5	60·0	64·6	67·9	73·2	49·0	34·5	49·4
8.	31·5	38·0	39·5	42·6	56·3	53·8	68·3	66·5	62·0	50·1	36·3	50·9
9.	29·7	34·5	40·8	39·6	58·6	56·3	70·4	64·8	61·0	51·5	38·5	42·6
10.	30·3	44·5	43·9	40·6	55·4	59·9	66·8	69·5	61·0	51·6	39·6	48·3
11.	31·0	43·5	43·8	40·0	54·3	59·8	68·3	65·5	60·3	49·0	42·4	49·9
12.	38·4	37·0	47·0	37·3	56·5	64·1	66·0	62·6	61·1	53·2	43·2	38·5
13.	45·2	42·4	49·8	41·6	55·9	68·2	68·1	60·1	56·0	51·1	42·7	44·9
14.	46·9	44·0	47·8	45·9	58·3	68·8	68·0	61·3	56·2	47·5	42·4	50·3
15.	44·9	40·5	42·6	46·8	61·8	64·6	72·1	66·5	56·9	49·9	37·8	51·4
16.	44·8	38·2	45·4	52·3	60·6	65·9	75·9	65·6	57·6	49·7	38·1	47·1
17.	48·5	41·3	43·7	50·8	59·8	68·7	72·6	62·7	58·5	47·2	42·7	47·7
18.	45·5	42·0	42·2	45·2	58·6	62·4	72·5	63·7	57·9	42·6	43·1	49·7
19.	43·6	42·9	41·9	48·1	71·4	59·7	69·2	63·2	56·5	38·2	41·4	41·4
20.	36·7	40·5	41·4	48·7	59·0	67·4	72·0	59·6	60·5	37·0	35·2	41·4
21.	36·7	47·7	50·5	53·2	56·0	69·9	76·6	61·8	59·1	43·6	40·2	49·2
22.	37·3	44·3	48·3	54·0	57·7	58·8	77·9	57·0	60·3	43·3	49·6	47·8
23.	33·7	39·1	39·2	49·6	53·5	58·8	63·3	57·4	56·8	45·7	45·5	42·4
24.	33·0	48·0	37·5	50·0	53·6	60·4	61·6	57·5	57·0	47·5	38·5	45·1
25.	40·9	51·4	38·8	47·5	57·6	63·2	63·8	58·4	54·7	51·2	40·7	40·2
26.	37·5	48·5	43·8	52·2	58·0	64·2	68·8	57·7	60·2	46·6	43·4	43·5
27.	37·8	46·5	48·0	50·1	58·2	69·8	74·0	60·3	59·5	42·1	40·6	49·0
28.	46·7	48·7	43·3	46·2	61·0	63·8	74·4	56·9	56·6	43·6	39·4	43·8
29.	38·9	45·9	39·9	55·3	63·6	60·1	58·5	58·4	57·5	45·3	35·6	40·9
30.	41·9	...	39·9	56·2	62·3	61·4	64·7	62·1	53·2	46·1	40·6	36·2
31.	47·8	...	44·4	...	59·2	...	66·2	62·8	...	52·5	...	37·5
Sums ...	224·5	87·7	124·4	242·5	226·7	60·8	232·2	110·4	14·9	244·5	44·6	185·7
Means...	37·2	43·0	44·0	48·1	57·3	62·0	67·5	63·6	60·5	47·9	41·5	46·0

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At Greenwich the year 1868 was ushered in with cold weather, which lasted till the 11th of January, the wind being generally from the N.E. On the 12th day a change was experienced, the wind veered to the S.W., and the temperature increased and passed above the average, and continued so for the most part till the end of September, the exceptions from an excess of temperature being few in number and small in amount; the greatest daily deficiency during this period was on the 12th of April, when it amounted to nearly 7½°, the greatest excess being on the 19th of May, when it amounted to rather more than 18°, the next greatest excess being on the 22nd of July, amounting to 16¼°. On this latter date the mean temperature was 77°·9, which is the highest mean daily temperature ever before recorded. From the end of September to the beginning of December (with the exception of the first week in November) the mean daily temperature was almost constantly below the average, the deficiency amounting to 12° on the 20th of October and 6th of November. From the beginning of December to the end of the year the mean daily temperature greatly exceeded the average, with the exception of the 11th, when the deficiency amounted to 2° only.

The highest temperature occurred on the 22nd of July, when it was 96°·6, a higher temperature than has ever before been recorded at Greenwich; the lowest temperature was registered on the 3rd of January, when it was 22°·8, showing a yearly range of temperature of 73°·8.

Dividing the year into different groups, we find that for the first eleven days the mean daily temperature averaged 6½° daily in defect; in the eighty days from the 11th of January to the 31st of March the average daily excess was rather more than 3½°; for the ninety-one days from the 31st of March to the 30th of June this excess was 3°·1, for the 171 days from January 12th to June 30th it was 3¼°, for the ninety-two days from the 30th of June to the 30th of September it was very nearly 3¼°, and for the 263 days from January 12th to September 30th it was 3¼° daily. In no year back to 1771 has the excess of temperature been so large as this for so long a period.

Atmospheric pressure.— During the month of January the readings of the barometer fluctuated considerably, the falls in the readings being accompanied by violent gales of wind. In February the readings were generally high, at times reaching 30·4 inches; from the 27th of this month to the 12th of March was a

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period of depression below the average; on the latter day a change occurred, and the readings were almost constantly above the average till the end of July. From the 1st to the 24th of August the readings were generally in defect of the average, a rapid fall from 29·84 ins. on the 20th to 29·05 ins. on the 22nd being accompanied by a violent gale. The readings were high from the 25th of August to the 6th of September; on the 11th of the latter month a change took place, and from that date to the end of November the readings oscillated above and below the average. On the 8th of December a rapid rise took place, which was followed by a sudden fall on the 11th accompanied by a great gale from the S.S.W. Violent gales were also experienced on the 27th and 28th, pressures of more than 30 lbs. on the square foot being recorded; like the rainfall, the pressure of the atmosphere during the last month of the year was very remarkable, the readings being, with one exception, below the mean daily average of twenty-seven years.

Rainfall.—The month of January was distinguished for its great rainfall, amounting to 4·2 ins., being 2·4 inches above the average of fifty-three years. The fall of rain in February was 1·3 in. and in March 1·1 in., and was below the average in the respective months to the amount of 0·3 in. and 0·5 in. In April it was slightly in excess, being 0·4 in. above the average, which was followed by a deficiency to the amounts of 0·5 in., 1·5 in., and 1·3 in. in the months of May, June, and July. The rainfall for August was 0·1 in. above the average, the amount being 2·5 ins.: 1·5 in., 2·6 in., and 1·2 in. are the amounts of rainfall for September, October, and November, and are respectively 0·9 in., 0·2 in., and 1·2 in. below the averages for those months. December was remarkable for the large amount of rainfall and for the continuance of wet weather; the amount was 5·4 ins., which is the greatest rainfall recorded in that month during the last fifty-four years.

Periodical Phenomena 1868.

Snowdrops in flower on January 28 in Cornwall.
" " " February 7 in Northumberland.
Woodcock departed from Helston on February 20.
Swallow and Wryneck both arrived at Guernsey on March 31.

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Cherry in blossom on the 10th of March at Helston in Cornwall, varying to the 31st at some places.

Field-elm leaf-buds *first appeared*

On the 16th of February at Boston.
„ 17th „ „ Weymouth.
Not till March 17 in Norfolk.

Horse-chestnut leaf-buds *first appeared*

February 20 at Eastbourne.
„ 24 at Boston.
„ 26 at Helston.

Sycamore leaf-buds *first appeared*

February 17 at Boston.
„ 19 at Weybridge Heath.
Not till March 14 at Guernsey.
„ „ 17 at Holkham.
„ „ 19 at Helston.

Hawthorn leaf-buds *first appeared*

February 10 at Eastbourne and Weybridge Heath.
„ 15 at Guernsey.
March 9 at Holkham in Norfolk.
„ 14 at Hull.

Hawthorn in leaf February 27 to March 25.

Apple in blossom March 31 at Guernsey and south of England.

Pear in blossom February 14 at Guernsey, varying to March 31.

Peach in blossom February 25 at Guernsey, varying to March 15.

Plum in blossom February 25 at Guernsey, from the 11th to end of March in England.

The month of March, though less settled than February, was favourable to agricultural pursuits, and very good progress was made in ploughing, sowing, and planting.

Oak in leaf.....	from	27th of April	.....	to 16th of	May.
Sycamore in leaf		20th of March	...	15th	„
Lime in leaf		4th of April	.....	9th	„
Horse-chestnut in leaf		21st of March	.....	3rd	„
Lilac in blossom		4th of April	.....	25th	„
Laburnum in blossom		14th „	.....	14th	„
Apple in blossom generally		5th „	.....	30th of	April.
Pear in blossom	„	5th „	.....	20th	„
Cherry in blossom	„	4th „	.....	28th	„
Plum in blossom	„	3rd „	.....	6th	„

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Wheat in ear.....	from 24th of May	..... to 27th of June.	
Wheat in flower	5th of June	..... 30th	„
Barley in ear.....	5th „	..... 29th	„
Barley in flower	10th „	..... 18th	„
Oats in ear.....	7th „	..... 30th	„
Wheat cut	7th of July	..... 8th of August.	
Barley cut	3rd „	..... 12th	„
Oats cut.....	6th „	..... 4th	„
Apple ripe	20th „	..... 28th	„
Pear ripe	28th „	..... 30th	„
Peach ripe	5th of August	... 28th	„ at Culloden.
Plum ripe	5th „	... 22nd of August in Ireland.	
Lime leafless	17th of October	... 2nd of November.	
Horse-chestnut leafless	8th „	... 30th of October.	
Common Poplar leafless	12th „	... 7th of November.	
Hawthorn leafless.....	7th „	... 24th	„
Woodcock arrived.....	6th „	... 5th	„
Swallow departed	3rd „	... 12th	„

The month of April was favourable for agricultural pursuits, and at its end there was every prospect of an early and plentiful harvest.

May was remarkable for brilliant sunshine, high temperature, the general forwardness of the season, and the promising appearance of cereal crops.

June was favourable to the ripening of the wheat-crops, but injurious to grass-lands, and to all spring and root-crops.

The hay-crop was housed in good condition at an unusually small expense; the quality was good, but the bulk was stated to be small.

At the end of the month of July the harvest was progressing in almost every part of the British Isles, and in some of the southern districts was brought near to completion. Harvest came in suddenly and nearly simultaneously in all parts of the country; and the crops proved to be in such a perfect state, that cutting, carrying, thrashing, and grinding into flour followed in rapid succession. There were many sudden deaths from sunstroke during the month. The want of water was severely felt, and this, com-

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bined with the great heat, acted injuriously both on animal and vegetable life to an extent unprecedented, so far as I can trace in this country. Pastures and grass-lands were generally brown and bare; in many places not a blade of grass was to be seen.

At the end of August the harvest was nearly completed, pastures and grass-lands were of their ordinary verdant appearance; the rainfall changed the appearance of the fields in a very short time, and root-crops were benefited by the moisture.

The month of September was favourable to agricultural pursuits. Towards the end of the month heavy rain fell all over the country and brought general relief to animal and vegetable life. Ponds and wells recommenced to yield their usual supply of water; streams and currents were filled. The rain loosened the ground for the plough; and the potato-crop was, upon the whole, spoken of with satisfaction.

To the end of the year there was a remarkable abundance of grass, and cattle were generally out of doors, and fortunately making but little demand for their keep on stock.

XXXVI. *On the Rotation of the Wind between oppositely directed Currents of Air in the Southern Indian Ocean.* By CHARLES MELDRUM, Esq., M.A., F.M.S.

IN the notice on this subject which I had the pleasure to read at the last Meeting of the Society, it was stated that the direction of the rotation of the wind seemed to depend, in the first place, upon the *relative positions* of the two oppositely directed currents of air, which observation had shown to be invariably connected with the revolving storms of those latitudes.

I now beg to offer one or two more remarks, with reference more especially to the extra-tropical gales between 30° and 45° S. lat.

The law which I ventured to indicate, namely, that the rotation is direct when the southerly is to the westward of the northerly current, and retrograde when the southerly is to the eastward of the northerly current, would evidently apply if the currents were superposed upon one another, and the rotation occurred in a vertical in place of a horizontal plane. For if the southerly

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current were on the surface and the northerly current above it, and then the whole system were inclined towards the right, until the northerly current reached the surface to the east of the southerly one, the rotation would be direct; whereas, if the inclination took place towards the left, until the northerly current reached the surface to the west of the southerly one, the rotation would be retrograde. If, again, the northerly current happened to be on the surface, and the southerly current above it, the rotation would be retrograde when the system was inclined to the right, and direct when inclined to the left.

I mentioned that cases occurred in which the same northerly current on the surface formed the east side of a system of direct rotation, and the west side of a system of retrograde rotation; and the conjoint systems were illustrated by a figure which was almost a fac-simile of what had been observed by vessels at sea.

On looking at that figure (fig. 4, p. 285), it will be seen that it bears a close resemblance to the graphical representations usually given of convection currents produced by heating a liquid in a vessel placed over the flame of a spirit-lamp. In the centre of the vessel there is an upward current of heated particles of the liquid, and on each side of that current a downward one of colder particles; so that there are two systems of rotation, which, when inverted, exactly resemble our two systems of aërial rotation.

The question arises, then, whether the two systems of air revolving in contrary directions may not be caused by the northerly current alone, carrying with it to the colder region where it comes down to the surface, after passing over the trade-wind, the heat which it stored up in the vicinity of the equator, the southerly current found on each side of it being merely a local effect of disturbed equilibrium.

In support of this view, we have the observed fact that the northerly current is sometimes as much as 10° warmer than the southerly currents, and also that it makes its appearance on the surface in the localities where the equatorial descending current might be expected to appear.

On the other hand, we know that the upper return current from the polar regions also comes down to the earth's surface about the same localities, and pursues its course thence to the equatorial calms, as the south-east trade-wind. Moreover, there are alternate bands of these northerly and southerly currents often occupying many degrees both in latitude and longitude;

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and the temperature of the southerly current seems to be fully as much below the mean temperature of the latitude as that of the northerly current is above it.

It would appear, therefore, that the systems of aërial rotation in question are produced between two independent currents, the one equatorial and the other polar, which are of different temperature, density, and moisture; and that, in so far as they are phenomena of convection, both currents are concerned.

The figure, exhibiting the two systems as observed in nature, bears a still closer resemblance in form and direction to the two systems of electric currents of contrary rotation induced in a metallic disk rotated under the influence of the poles of a powerful magnet.

But to connect the one phenomenon with the other in the relation of cause and effect, it would be necessary to show that the electric currents are produced *first*, and that the aërial currents appear *afterwards*, and then pursue the course of the electric currents; and there does not seem to be any ground for supposing that this is the case.

There is reason for thinking, however, that when once the systems of aërial rotation are formed, electric currents are induced under the combined actions of terrestrial magnetism, friction, and alternations of temperature; for not only would this be in conformity with known laws, but observation shows that cyclones are often attended by electricity, and that sometimes the compasses on board ships in storms are greatly affected. When a connexion of this kind shall have been fully established between meteorology and magnetism, it will evidently embrace a wide range of phenomena, terrestrial and cosmical; but with regard to the systems of atmospheric rotation under consideration, electricity appears to be an effect rather than a cause.

Upon the whole, then, and as stated on former occasions, the direct rotation of the wind in the tropical hurricanes of the Southern Indian Ocean appears to be due, first, to the relative positions of the currents, equatorial and polar, between which they are formed; and, secondly, partly to aqueous precipitation, and partly to the ascent of heated air, in the intervening space. In the retrograde rotation, not unfrequently observed in extra-tropical latitudes, the air seems to be drawn in towards the centre by the effect of the earth's rotation; whereas, in the direct rotation, the action appears to be the reverse.

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CORRESPONDENCE, &c.

To the Editor of the Meteorological Society's Proceedings.

Meltham,
March 15, 1869.

DEAR SIR,—In about two hours after I had posted a letter to you, the town of Meltham was visited with a slight shock of an earthquake; and thinking that it might not have extended very far, and that you will not in consequence hear anything of it, I shall just relate in a very simple manner what came under my own observation. At 15 minutes past 6 o'clock in the evening, I had my house completely to myself, which is not ofttimes the case, and being engaged with some optical experiments in an upper room, where I have some large telescopes, a model of the moon, and a many other things of a similar description, I became at once greatly surprised by a sudden vibration of the doors and windows of the room as well as, also, of the different things in the room.

Feeling convinced that nothing less than an earthquake could produce such effects, I descended from the room and found, on my going out of doors, a number of people collected together who had left their houses in consequence of the shock.

The day had been very cold up to the time of the shock; the temperature rose from 50° to 53° or 54° Fahr.; the barometer stood midway from its greatest and its least heights, what we call change. My situation is 600 feet above the sea-level. There was little or no wind; what did blow came from south-west, and the atmosphere was filled with large white clouds at the time of the phenomenon.

The shock continued, as near as I can ascertain from other people, about 5 or 6 seconds; I am sorry I did not notice the length of time myself.

Yours truly,
GEORGE CREASUR.

P.S. I find that the earthquake was general in some parts of Lancashire on Tuesday morning; and the accounts agree pretty well with the above, which I wrote a few minutes after the phenomenon, or, rather event, took place; there is no doubt but that you will have more scientific explanation than I give.

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Over Court, near Bristol,
27th of February, 1869.

My dear Sir,—The self-recording ozonometer made for me by Mr. Casella on a plan I suggested to him about a year ago has been working since the 13th of this month.

It records the amount of ozone developed each hour, so far, at least, as this is indicated by Schönbein's test-papers.

I enclose a specimen of its working during the past week, in case you may think it worth while bringing it before the Society.

By referring to this specimen, several remarkable changes will be noticed.

The following is a short description of the instrument:—

Two cylinders (one large and the other small) are inclosed in boxes, the openings of which are guarded by india-rubber lips. The boxes are $2\frac{1}{4}$ inches apart. The large cylinder is moved round $2\frac{1}{4}$ inches each hour by means of a driving-shaft attached to the clock.

A strip of test-paper about $\frac{5}{8}$ of an inch wide and 5 feet long is rolled round the small cylinder, the free end of it being fastened to the large cylinder; $2\frac{1}{4}$ inches of paper are thus exposed to the influence of the atmosphere.

The clock, which goes eight days, indicates the minutes only, and *shifts the paper*, by causing the large cylinder to rotate $2\frac{1}{4}$ inches of its circumference, *exactly at the hour*, thus removing the portion of paper ($2\frac{1}{4}$ inches long) exposed during the past hour, and exposing a fresh portion, to be in its turn removed at the end of another hour and succeeded by a new piece, and so on.

At the end of the twenty-four hours the whole strip of test-paper is unrolled by the observer from the large cylinder, dipped, and read by the scale (Schönbein's); a fresh strip is then rolled round the small cylinder, and its free end is attached to the large cylinder, as before.

The instrument is inclosed in a louvre-boarded case, and exposed in an airy but sheltered situation, on the side of, and near the bottom of, a hill.

With this instrument it will be easy to determine the diurnal and other periods of ozone development, should such exist.

Very sincerely yours,

R. C. Cann-Lippincott.

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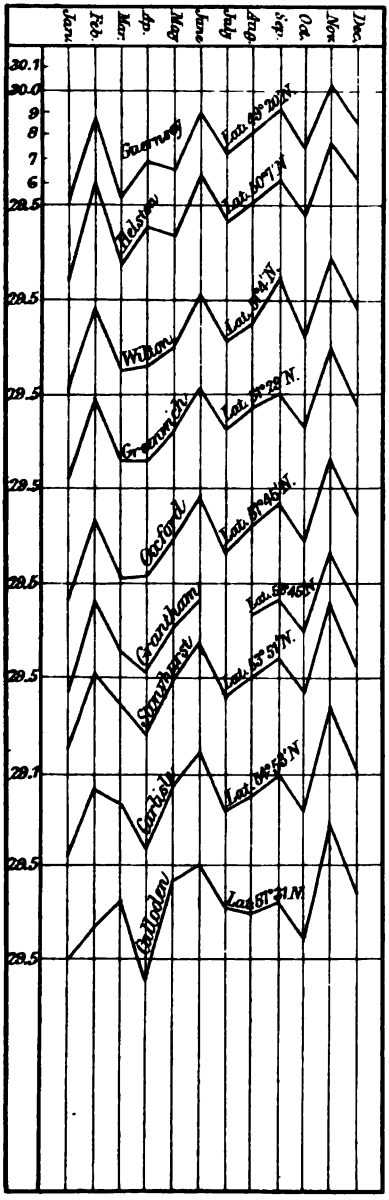
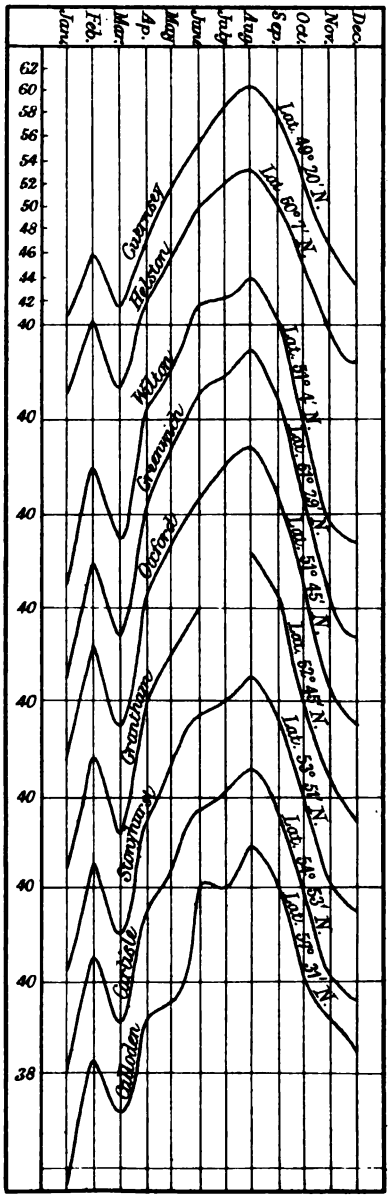
BAROMETER 1867.

Curves showing the Mean Monthly Atmospheric Pressure, 1867.



MEAN TEMP. 1867.

Curves showing the Mean Monthly Temperature of the Air, 1867.



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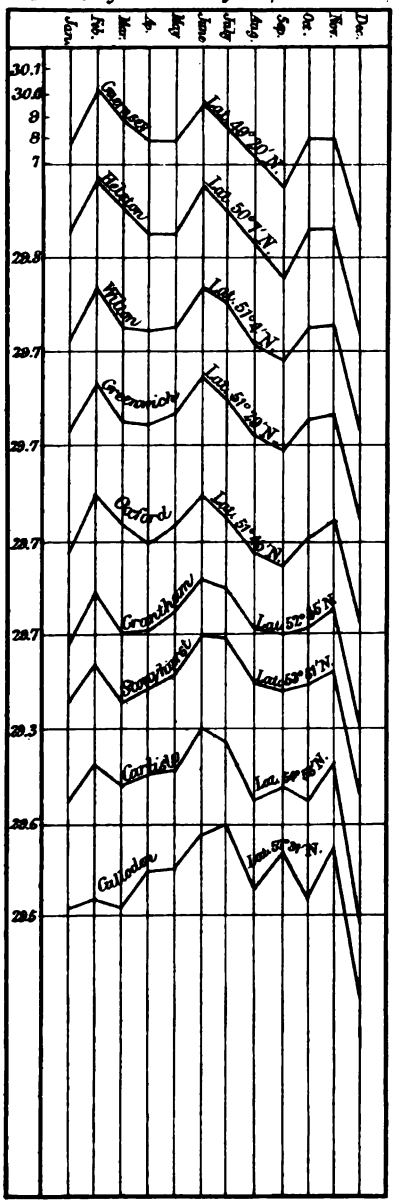
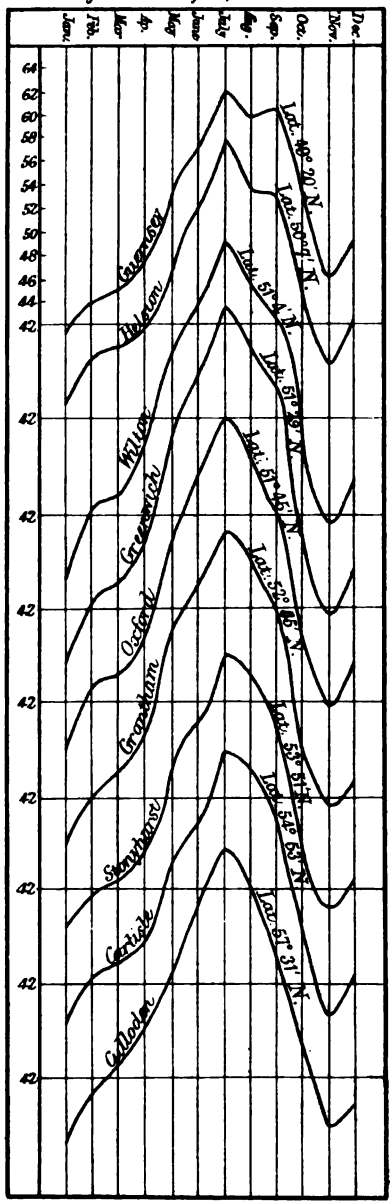
BAROMETER 1868.

Curves showing the Mean Monthly Atmospheric Pressure, 1861.



MEAN TEMP. 1868.

Curves showing the Mean Monthly Temperature of the Air. 1868.



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OF

THE METEOROLOGICAL SOCIETY,

Session 1868–69,

25 GREAT GEORGE STREET, WESTMINSTER, S.W., at 7 P.M.

1868. November	18	1869. March.....	17
1869. January	20	„ April	21
„ February.....	17	„ June	16

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Vol. IV.] [No. 43.

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OF

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EDITED BY

JAMES GLAISHER, Esq., F.R.S., President.

1869, APRIL 21.

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JAMES GLAISHER, Esq., F.R.S., President.

Vol. IV. 1869, APRIL 21. [No. 43.

JAMES GLAISHER, Esq., F.R.S. &c., President, in the Chair.

W. J. Lancaster, Esq., Colmore Row, Birmingham;
Rev. S. J. Perry, Stonyhurst College, Blackburn;
were balloted for and duly elected Fellows of the Society.

The Names of three Candidates for admission into the Society were read.

XXXVII. *The Influence of the Moon on the Amount and Frequency of Rainfall as dependent on her Age.* By James Glaisher, Esq., F.R.S., &c.

In a paper by George Dines, Esq., one of the Members of our Council, read on March 18, 1868, "On the Influence of the Moon upon the Fall of Rain in respect to her Age," based upon daily observations made at Cobham through a period of forty years, the author arrives at the conclusion that the fall of rain is in no way influenced by the changes of the moon or by the moon's age.

The daily observations of rain were begun at Greenwich by

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Mr. Pond, the late Astronomer Royal, on January 1, 1815, and daily observations have been made up to the present time, with the exception of a few instances, when the readings have not been taken so frequently or when the rain-gauge was out of order; these instances I have filled up from another Journal taken in the same latitude as Greenwich.

These observations, extending over a period exceeding half a century, are available for the investigation as to the influence or non-influence of the moon in respect to her age.

Several years since I began this investigation by copying out the fall of rain on every day, from the year 1815 to the year 1860, this being the first step necessary in the investigation; and these Tables I have completed to January 14, 1869. The next step was the selecting, from the several nautical almanacs, the day of every new moon during the period. The third step was arranging the daily rainfall in every year according to the moon's age, in the following manner:—starting from the year 1815, the day of new moon was on January 10; the rain which fell on that day was placed under the day of new moon: no rain fell on January 11th, 12th, or 13th; but some did fall on January 14th, and this was placed under the fourth day of the moon's age, and so on till February 8th, the end of the lunation. The rain which fell on February 9th, the day of next new moon, was placed at 0 day, considering the day of new moon as 0, and when 1 day old, as age of the moon 1 day, &c., and in this way fifty-four Tables were formed, being one for every year, of which the following is a specimen, being the first of the series:—

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Year 1815.

Date of New Moon.	Age of the Moon in Days.																												
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January 10...	·02	...	...	...	·21	...	...	·02	...	...	...	...	...	...	...	...	...	...	·26	·05	·01	·13	·06	·05	·01	·09	...	...	·01	...
February 9...	·10	·01	·02	·12	·23	...	·07	·03	·12	·08	...	·02	·16	...	...	...	...	...	·02	...	...	·02	·06	...	...	...	...	·25	·18	·14
March 11 ...	·02	·07	·20	·20	·08	·07	·01	...	·15	...	...	·02	·12	·04	·08	...	·12	·16	·01	...	...	...	...	·02	...	...	...	...	...	...
April 9	...	·65	...	·01	...	·50	...	...	...	...	...	...	·03	·60	·24	·21	...	·17	...	...	...	·04	·09	...	·62	...	...	·15	·02	·08
May 9.....	...	·01	·04	·42	·21	·10	·02	·10	...	...	·02	...	·03	·01	...	·10	...	...	...	...	...	·12	...	·10	...	·01	...	...	...	·02
June 7	·23	...	...	...	...	...	·13	·50	·07	...	·28	·12	...	...	...	·01	·10	...	·08	...	...	...	...	...	...	...	...	...	...	...
July 7.....	·12	...	...	...	...	...	...	·05	...	...	...	...	·38	·67	·15	...	...	·03	...	·15	·02	...	...	...	...	...	...	...	...	...
August 5.....	...	·20	...	...	...	...	...	·04	·18	·01	...	...	·12	...	·32	...	...	...	·59	·10	...	...	...	...	·27	...	...	...	...	...
September 3	·03	...	·01	...	...	...	...	...	...	...	...	...	...	...	·10	...	...	...	...	...	·18	·05	·21	...	·09	·12	·16	·12	·18	...
October 2 ...	·06	...	...	...	·29	·01	...	...	...	...	·47	...	·01	...	...	·01	...	·28	·01	...	...	·01	·36	·10	...	...	·50	·10	...	...
November 1	...	...	...	...	...	...	·23	·02	·44	·02	...	·06	·46	·07	...	·03	...	...	...	...	...	...	...	...	·02	...	·01	...	...	...
„ 30	·01	·05	·02	·08	·09	·01	·30	·07	·10	...	...	...	...	·01	·01	·02	·09	·04	...	...	·50	·33	...	·01	...	...	·02	·21	·02	·07
December 30	...	...	...	...	...	...	...	·07	...	·18	·07	·17	·18	...	·12	...	·07	·14	·39	...	·02	·02	·09	·16	...	·02	...	...	·19	·01
Sums	·59	·99	·29	·83	1·11	·69	·76	·90	1·06	·29	·84	·39	1·49	1·40	1·02	·38	·38	·82	1·36	·30	·73	·72	·87	·44	1·01	·24	·69	·83	·60	·32

The next process was taking the sums of the numbers in these Tables under every day of the moon's age, and these were then collected together, and in this way the following Table was formed.

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TABLE I. Showing the Rainfall on every Day of the Moon's

Years.	Age of the														
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1815.	0·59	0·99	0·29	0·83	1·11	0·69	0·76	0·90	1·06	0·29	0·84	0·39	1·49	1·40	1·02
1816.	0·46	0·15	1·63	0·25	0·11	0·69	0·46	0·75	1·64	1·13	2·32	0·99	1·19	2·85	1·26
1817.	1·31	1·40	0·45	0·85	1·28	1·22	1·38	1·48	1·35	0·99	0·96	0·21	0·43	0·72	0·68
1818.	0·35	0·16	0·65	0·91	2·58	1·25	1·04	0·60	0·27	0·65	0·36	0·26	1·20	0·79	0·62
1819.	1·78	1·30	0·40	1·08	0·35	1·00	1·17	0·71	0·29	0·56	1·72	1·71	1·41	0·46	0·93
1820.	0·75	0·06	0·34	0·33	1·31	1·79	1·86	0·97	1·88	1·16	0·26	2·22	0·29	1·34	0·73
1821.	0·71	1·49	1·02	2·38	1·07	1·64	1·30	0·55	2·01	1·27	0·52	0·79	0·98	0·84	1·08
1822.	0·10	1·06	0·63	1·45	1·26	1·16	0·69	0·48	0·56	1·28	1·77	0·39	0·78	0·74	0·44
1823.	0·67	1·02	0·31	0·42	0·46	0·85	0·46	0·54	0·38	0·11	0·07	0·67	0·01	1·29	0·16
1824.	0·98	0·70	0·77	0·58	1·32	0·63	0·41	0·58	0·28	1·83	0·84	1·07	0·57	0·69	2·33
1825.	0·15	0·26	1·11	...	0·32	1·87	0·92	0·16	1·00	1·63	0·91	0·08	0·27	0·40	2·06
1826.	0·44	0·72	0·66	0·11	1·48	0·98	0·86	1·30	0·17	0·81	0·35	0·39	0·43	0·35	1·28
1827.	0·96	0·81	1·05	1·42	0·93	0·51	0·60	0·20	0·35	1·59	1·84	0·75	0·32	0·04	0·59
1828.	1·61	0·56	1·41	1·55	1·97	1·23	0·55	0·29	0·69	1·18	2·19	1·26	0·90	0·56	0·61
1829.	0·28	1·20	...	0·42	0·40	1·22	1·37	0·02	0·15	1·64	0·72	0·89	1·23	0·28	...
1830.	0·50	2·50	0·65	0·99	0·88	0·65	0·24	1·16	0·74	1·16	0·24	1·09	2·63	0·36	0·67
1831.	0·88	0·91	0·79	1·39	1·52	0·62	1·99	1·81	1·56	0·30	0·16	1·01	1·43	1·23	0·69
1832.	0·31	1·44	2·63	1·09	1·02	1·50	1·75	0·66	1·55	1·49	0·82	0·69	2·04	2·06	1·67
1833.	1·29	1·15	0·82	0·55	1·14	0·86	1·08	0·62	1·30	1·82	0·79	0·87	1·73	0·88	0·71
1834.	0·95	1·15	1·07	0·81	0·89	1·60	0·56	1·38	0·76	0·37	0·20	0·06	1·71	1·05	1·49
1835.	2·03	1·12	0·84	1·45	1·02	0·41	1·83	0·82	1·70	1·72	0·72	1·70	0·63	0·82	0·47
1836.	0·58	0·82	0·96	0·49	0·61	0·50	0·59	1·06	1·49	0·63	2·01	0·91	1·42	0·71	0·61
1837.	0·67	0·22	0·23	0·49	1·33	0·09	0·58	1·12	0·47	0·34	0·32	0·31	0·39	0·46	0·67
1838.	0·51	0·90	0·77	0·90	0·51	0·40	1·18	0·59	1·14	3·46	1·00	0·86	1·18	0·21	0·76
1839.	0·43	0·30	0·33	0·26	0·61	0·55	0·63	1·77	1·29	1·12	1·51	1·48	0·94	1·72	0·40
1840.	0·53	0·40	1·04	0·50	0·20	0·45	0·36	1·15	0·70	0·49	0·42	0·23	0·53	0·83	0·72
1841.	0·48	1·28	0·52	0·36	1·00	1·36	0·88	0·56	1·65	1·50	0·31	0·76	0·94	1·78	0·57
1842.	0·43	0·62	0·20	0·35	1·62	0·03	0·33	0·15	0·23	0·11	0·91	1·03	0·33	1·76	1·10
1843.	0·19	1·12	0·23	0·34	1·00	0·45	1·06	1·00	1·93	1·30	0·74	0·73	0·26	0·53	0·59
1844.	0·71	0·39	0·83	0·65	1·49	0·94	0·01	0·29	0·63	1·07	0·83	0·12	0·16	1·03	0·41
1845.	0·89	0·21	0·44	1·11	0·26	1·34	0·20	0·75	0·83	0·46	0·32	0·01	0·64	0·27	0·12
1846.	0·72	0·61	0·70	2·15	0·44	1·03	0·57	0·61	0·97	1·42	0·68	0·20	1·56	0·58	0·07
1847.	0·47	0·54	...	0·25	1·35	0·13	0·18	0·13	0·26	0·24	0·59	0·63	0·33	0·15	0·56
1848.	1·05	1·70	2·28	1·62	0·62	0·75	1·23	0·53	0·34	1·79	0·86	2·71	1·23	0·51	0·92
1849.	1·14	0·89	0·28	0·62	1·14	1·93	1·97	1·17	0·36	0·39	0·54	0·44	0·26	0·25	1·13
1850.	0·82	0·45	0·12	0·18	0·67	1·09	0·54	0·24	0·64	0·48	0·47	0·68	0·34	0·53	1·53
1851.	0·48	0·72	0·89	0·94	0·23	0·67	0·39	0·39	0·42	0·61	0·23	1·03	1·72	0·29	0·65
1852.	1·57	1·26	1·22	0·92	0·63	1·23	0·58	1·09	2·49	1·26	1·27	0·34	1·10	0·56	0·33
1853.	0·53	0·40	1·00	0·93	0·15	1·00	1·19	1·68	3·34	0·47	0·92	0·42	0·88	0·97	0·79
1854.	0·22	0·72	0·40	0·99	1·37	0·35	0·37	0·90	0·42	1·59	0·59	1·08	0·74	0·29	0·64
1855.	0·24	0·34	1·02	0·26	0·40	0·56	0·61	0·27	0·09	0·22	0·54	0·44	1·49	0·30	0·64
1856.	0·18	0·21	0·97	0·82	0·27	0·52	0·63	0·40	0·67	1·54	0·36	1·36	1·08	1·19	2·04
1857.	0·49	0·37	0·15	0·11	0·23	2·72	0·39	1·04	0·52	0·30	0·36	0·23	0·29	0·41	0·49
1858.	1·13	1·34	0·15	0·19	0·28	0·73	0·67	0·05	0·18	0·13	0·50	0·68	1·01	0·26	0·50
1859.	1·93	1·18	0·56	1·31	1·36	0·82	1·12	0·20	0·58	0·62	0·74	1·14	1·21	0·23	0·62

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Age in each of the Lunations for the years 1815–1868.

Moon in Days.														Years.
15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	
in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
0·38	0·38	0·82	1·36	0·30	0·73	0·72	0·87	0·44	1·01	0·24	0·69	0·83	0·60	0·32	1815.
0·83	1·43	1·14	0·95	1·31	0·78	0·71	1·00	0·42	0·42	0·31	0·92	0·46	0·75	0·46	1816.
0·67	1·23	0·55	0·92	0·59	0·88	0·29	0·86	0·84	0·29	0·66	0·44	0·43	0·70	0·56	1817.
0·42	0·83	0·79	1·13	0·94	1·03	0·48	0·77	0·44	0·36	0·89	2·46	0·47	1·32	0·36	1818.
1·43	0·31	0·68	1·08	0·46	0·47	0·34	0·85	0·63	0·20	1·09	1·14	0·66	1·78	0·80	1819.
0·65	0·40	0·62	1·06	0·20	0·35	1·77	0·27	0·43	0·44	0·71	0·05	...	...	...	1820.
0·26	0·83	1·86	0·64	0·41	0·15	0·27	0·60	1·41	1·04	1·31	1·22	1·23	0·42	0·56	1821.
0·25	2·44	0·73	0·05	0·74	1·02	0·56	1·33	1·75	1·19	0·46	0·38	0·24	0·75	0·41	1822.
0·23	1·24	2·38	1·14	1·62	0·83	0·63	0·33	0·45	1·39	0·84	0·75	3·70	0·72	0·45	1823.
2·28	1·17	3·07	2·31	2·87	0·76	1·64	1·02	0·67	0·71	0·32	0·49	1·01	1·33	0·36	1824.
1·21	0·03	0·10	0·72	0·66	1·04	0·85	0·72	0·70	0·27	2·91	0·43	0·22	0·10	0·78	1825.
0·25	0·63	0·77	0·91	2·20	0·31	0·07	0·95	1·88	1·26	0·54	0·41	0·50	0·10	0·25	1826.
0·42	0·43	0·37	0·83	1·48	1·27	0·57	0·94	1·43	0·37	0·40	1·32	1·24	0·83	1·08	1827.
0·74	0·12	0·04	0·87	0·55	0·32	0·14	1·71	0·57	0·19	0·50	0·46	1·25	1·46	0·02	1828.
1·59	0·74	1·73	1·23	0·16	0·94	1·15	0·59	1·15	0·70	0·90	0·26	0·03	0·72	0·62	1829.
1·16	1·78	0·76	0·42	0·32	0·69	1·19	0·76	0·94	1·90	1·40	0·09	0·78	1·71	0·68	1830.
0·60	1·08	1·59	1·07	0·30	1·12	0·50	1·69	0·11	3·68	1·70	1·27	1·17	0·64	1·09	1831.
0·67	0·43	1·13	1·01	0·33	...	0·46	1·19	1·49	0·74	0·57	...	0·16	0·12	0·24	1832.
1·75	1·18	1·11	0·18	0·99	0·77	0·89	0·27	0·50	1·28	2·40	1·06	1·04	0·92	0·22	1833.
0·31	0·28	0·49	0·36	0·59	1·38	1·13	0·30	2·24	0·47	0·75	0·10	1·21	0·30	0·06	1834.
1·02	1·80	0·79	1·00	0·02	0·29	0·25	0·91	1·08	...	1·59	1·25	0·79	1·13	0·80	1835.
2·67	1·28	0·46	0·45	2·43	1·31	1·20	1·43	0·60	0·94	0·26	1·55	0·88	...	0·48	1836.
0·55	0·57	0·60	0·35	0·44	1·67	0·40	1·61	0·85	0·20	1·15	1·04	0·48	1·28	0·92	1837.
0·70	0·29	0·62	0·32	0·93	0·45	0·77	0·55	0·04	0·18	0·20	0·18	0·41	0·94	0·23	1838.
0·80	0·99	0·63	1·57	0·85	1·47	2·39	0·57	0·32	0·32	0·91	0·94	0·91	0·54	0·31	1839.
0·41	0·62	0·30	0·30	0·80	0·60	0·58	1·74	0·55	0·82	0·49	1·02	0·38	0·60	0·46	1840.
1·23	2·21	0·55	0·99	1·05	0·49	0·45	0·41	0·60	0·28	1·22	1·86	0·52	0·59	0·35	1841.
0·79	0·09	0·37	1·04	2·49	0·86	0·99	0·81	1·66	0·10	0·62	0·94	0·64	0·29	0·08	1842.
1·19	0·64	0·50	0·66	0·58	0·13	1·30	1·09	0·67	0·57	0·04	0·78	3·16	0·28	0·39	1843.
1·42	0·09	0·08	0·53	0·82	0·75	1·37	0·70	0·71	0·18	0·75	0·47	1·07	1·07	0·43	1844.
1·59	1·48	0·51	0·51	1·41	1·26	0·44	1·25	0·52	0·46	0·45	0·60	0·37	0·91	1·28	1845.
0·25	0·73	0·43	0·49	0·57	...	0·69	0·16	0·26	0·79	1·48	0·76	1·04	1·23	0·14	1846.
0·17	0·05	0·31	0·82	0·21	...	...	0·56	0·50	1·31	0·35	0·58	1·10	0·61	0·30	1847.
1·40	0·61	0·97	0·35	0·42	0·61	1·32	1·41	1·66	0·96	1·17	0·50	0·68	0·48	0·48	1848.
0·72	0·62	1·06	1·21	0·51	0·59	0·73	0·29	...	0·82	0·56	1·04	0·68	1·47	0·14	1849.
0·52	0·88	1·08	1·57	0·69	0·96	0·29	0·28	0·26	1·52	0·36	0·32	0·52	0·28	0·16	1850.
0·37	0·84	0·67	0·60	1·46	2·02	0·84	0·96	0·31	1·95	0·56	0·51	0·40	0·75	0·33	1851.
2·26	0·78	0·75	0·49	0·29	0·81	2·97	1·40	0·81	1·19	0·91	1·30	0·56	0·52	0·55	1852.
0·83	0·35	1·60	1·32	0·47	0·67	1·52	1·85	0·91	0·66	2·82	0·58	0·88	0·55	0·32	1853.
0·33	0·41	0·46	0·38	0·20	0·40	0·31	0·37	0·30	0·25	0·78	1·17	0·27	0·69	0·06	1854.
1·50	0·28	0·91	0·88	1·37	0·77	0·62	0·57	1·08	1·25	0·89	0·46	1·83	0·64	0·30	1855.
1·00	0·37	0·97	1·88	0·75	0·54	1·05	1·01	0·22	0·93	0·45	0·27	0·59	0·93	0·80	1856.
0·78	1·31	0·68	0·69	0·75	1·52	0·19	0·09	1·52	1·17	0·32	0·82	...	1·41	0·04	1857.
0·31	1·01	0·48	1·25	0·33	0·83	0·54	0·24	1·64	0·74	0·27	0·56	0·43	0·95	0·22	1858.
0·50	0·55	1·57	1·19	1·22	0·52	1·86	0·74	0·14	0·38	0·27	0·90	1·32	0·51	0·39	1859.

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TABLE I. Showing the Rainfall on every Day of the Moon's

Years.	Age of the														
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1860.	0·30	1·14	1·28	0·82	1·03	1·05	1·06	0·80	1·06	1·09	0·92	2·09	1·08	1·21	0·27
1861.	0·55	0·37	2·04	0·98	0·52	0·74	1·48	0·53	0·76	0·57	0·35	1·44	1·17	0·16	1·32
1862.	0·48	0·14	0·24	0·75	0·11	0·20	0·88	0·30	1·13	1·13	1·38	1·57	0·63	1·27	0·80
1863.	0·04	0·41	0·33	2·06	0·17	0·19	0·43	1·02	0·54	0·11	0·32	0·88	0·92	0·55	0·17
1864.	0·28	1·30	0·30	0·52	0·27	0·64	0·02	0·59	0·38	0·26	0·18	0·30	0·11	0·23	0·50
1865.	2·39	0·47	2·31	1·53	0·81	0·38	0·05	2·22	1·19	1·50	0·78	1·06	1·46	0·78	1·25
1866.	0·49	1·33	0·47	0·17	0·83	1·08	0·93	0·37	0·70	0·67	1·40	0·83	0·59	1·96	0·59
1867.	0·97	1·39	0·34	1·45	0·68	2·27	1·38	1·34	0·88	0·46	0·62	0·82	1·17	0·79	0·91
1868.	0·51	1·31	1·56	0·56	0·69	0·15	0·86	1·53	1·05	1·21	0·99	0·78	0·51	0·50	1·05
Sums	39·50	45·00	41·68	44·44	45·30	48·71	44·63	41·82	49·02	51·52	42·56	45·08	49·34	42·42	43·21

By dividing this Table into groups of nine years, and taking formed.

TABLE II. Showing the Total Rainfall on every

Periods.	Age of the														
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
	ins.	ins.	ins.	ins.	ins.	ins.	ins	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
1815–1823.	6·72	7·63	5·72	8·50	9·53	10·29	9·12	6·98	9·44	7·44	8·82	7·63	7·78	10·43	6·92
1824–1832.	6·11	9·10	9·07	7·55	9·84	9·21	8·69	6·18	6·49	11·63	8·07	7·23	9·82	5·97	9·90
1833–1841.	7·47	7·34	6·58	5·81	7·31	6·22	7·69	9·07	10·50	11·45	7·28	7·18	9·47	8·46	6·40
1842–1850.	6·42	6·53	5·08	7·27	8·59	7·69	6·09	4·87	6·19	7·26	5·94	6·55	5·11	5·61	6·43
1851–1859.	6·77	6·54	6·36	6·47	4·92	8·60	5·95	6·02	8·71	6·74	5·51	6·72	9·52	4·50	6·70
1860–1868.	6·01	7·86	8·87	8·84	5·11	6·70	7·09	8·70	7·69	7·00	6·94	9·77	7·64	7·45	6·86

By glancing over the numbers in this Table, a difference is seen in every group except the 4th (1842–50) between the amounts before and after full moon, and those at the beginning and ending of the lunation, thus indicating a lunar influence. In the 4th group the sums of the numbers in the first and second weeks of the moon's age are nearly alike, and those in the third and fourth are nearly alike, the former being the larger.

The numbers under the 9th day (Mr. Dines's 10th) are very

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Age in each of the Lunations for the Years 1815–1868 (*continued*).

Moon in Days.															Years.
15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	
in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
1·23	0·58	0·61	0·92	0·54	0·99	0·90	0·81	1·38	0·54	0·86	0·72	0·86	1·05	0·15	1860.
0·68	0·12	0·61	0·74	0·80	1·69	0·60	0·10	0·65	0·26	0·57	0·18	0·27	0·46	0·90	1861.
1·19	0·60	2·26	1·68	1·50	1·19	0·96	1·47	1·53	0·41	1·03	1·04	0·68	0·39	0·18	1862.
0·56	0·14	0·34	0·96	0·38	1·15	1·43	1·00	0·18	0·94	0·40	0·62	1·08	0·19	0·08	1863.
1·16	1·42	0·71	0·48	0·39	0·18	1·30	0·95	0·39	0·35	1·64	0·49	0·71	1·61	0·38	1864.
1·29	0·96	0·15	0·17	0·86	0·95	0·85	0·20	0·15	2·00	0·31	0·42	0·38	2·19	0·84	1865.
0·56	0·29	1·91	1·59	1·65	0·37	2·03	0·35	1·22	0·60	0·99	2·43	0·52	0·37	1·16	1866.
1·62	1·22	1·57	0·79	1·04	1·25	0·26	0·36	0·50	0·97	4·26	0·51	0·12	1·21	...	1867.
0·79	0·57	0·65	0·28	0·27	0·88	0·60	1·09	1·96	0·99	0·27	0·20	0·61	0·87	0·88	1868.
48·49	41·71	46·89	46·69	45·51	43·01	46·36	44·35	42·66	42·94	48·10	40·95	41·77	42·26	23·85	Sums.

the sums of each day in the several groups, the next Table was

Day of the Moon's Age in periods of Nine Years.

Moon in Days.															Periods.
15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	
ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	
5·12	9·09	9·57	8·33	6·57	6·24	5·77	6·88	6·81	6·34	6·51	8·05	8·02	7·04	3·92	1815–1823.
8·92	6·41	9·56	9·37	8·87	6·45	6·57	9·57	8·94	9·82	9·24	4·73	6·36	7·01	5·12	1824–1832.
9·44	9·22	5·55	5·52	8·10	8·43	8·06	7·79	6·78	4·49	8·97	9·00	6·62	6·30	3·83	1833–1841.
8·05	5·19	5·31	7·18	7·70	5·16	7·13	6·55	6·24	6·71	5·78	5·99	9·26	6·62	3·40	1842–1850.
7·88	5·90	8·09	8·68	6·84	8·08	9·90	7·23	6·93	8·52	7·27	6·57	6·28	6·95	3·01	1851–1859.
9·08	5·90	8·81	7·61	7·43	8·65	8·93	6·33	6·96	7·06	10·33	6·61	5·23	8·34	4·57	1860–1868.

large in the second and third groups; they are also large on the 8th day in groups one and three: the largest number in the 4th group is under the 27th day, and those about the 8th and 9th days are much less; in the 5th, the largest number is under the 21st, and in the last group under the 11th.

By taking the groups of eighteen years, the following are the results:—

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TABLE III. Showing the Total Rainfall on every Day of the Moon's Age, in periods of Eighteen Years.

Periods.	Age of the Moon in Days.														
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
1815 } 1832 }	12·83	16·73	14·79	16·05	19·37	19·50	17·81	13·16	15·93	19·07	16·89	14·86	17·60	16·40	16·82
1833 } 1850 }	13·89	13·87	11·66	13·08	15·90	13·91	13·78	13·94	16·69	18·71	13·22	13·73	14·58	14·07	12·83
1851 } 1868 }	12·78	14·40	15·23	15·31	10·03	15·30	13·04	14·72	16·40	13·74	12·45	16·49	17·16	11·95	13·56
Sums	39·50	45·00	41·68	44·44	45·30	48·71	44·63	41·82	49·02	51·52	42·56	45·08	49·34	42·42	43·21

	Age of the Moon in Days.														
	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
1815 } 1832 }	14·04	15·50	19·13	17·70	15·44	12·69	12·34	16·45	15·75	16·16	15·75	12·78	14·38	14·05	9·04
1833 } 1850 }	17·49	14·41	10·86	12·70	15·80	13·59	15·19	14·34	13·02	11·20	14·75	14·99	15·88	12·92	7·23
1851 } 1868 }	16·96	11·80	16·90	16·29	14·27	16·73	18·83	13·56	13·89	15·58	17·60	13·18	11·51	15·29	7·58
Sums	48·49	41·71	46·89	46·69	45·51	43·01	46·36	44·35	42·66	42·94	48·10	40·95	41·77	42·26	23·85

By taking the sums of these numbers in each period of eighteen years, in two groups, those from 0 day to 7th day, and from 23rd to 29th day for the first group of fourteen and a half days, and those from the 8th to the 22nd for the second group of fifteen days, we find the sum—

	ins.		ins.
1815–1832, first group, to be	228·2	..... in the second	240·9
1833–1850, „ „ „	200·0	..... „ „	218·2
1851–1868, „ „ „	205·4	..... „ „	227·1

The numbers in the last line of Table III. agree with the sum of all the numbers in Table II.; they show the sums of the rainfall for the whole period, and indicate a decided lunar influence. The smallest number appears on the day of new moon, and the next in order on the 26th day. The smallest sum of any two

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consecutive numbers (omitting the 29th or half day) is 81·76 inches, being the sum of the day of new moon and the 28th day, and the next in order of smallness is 82·72 inches, being the sum of the 26th and 27th days. The smallest sum of any three consecutive days is 124·98 inches, being that of the 26th, 27th, and 28th days; the next in order is 126·18 inches, being that of the day of new moon and two following days.

The largest number in the Table is on the 9th day of the moon's age, viz. 51·52 inches (agreeing with Mr. Dines); and the next in order is the day preceding, viz. 49·02 inches.

The largest sum of any two consecutive days is 100·54 inches, being that of the 8th and 9th days (in agreement with Mr. Dines); the next in order is 94·42 inches, being that of the 11th and 12th days.

The largest sum of any three consecutive days is 143·10 inches, being that of the 8th, 9th, and 10th days; and the next in order is 139·09 inches, being that of the 17th, 18th, and 19th days.

Thus the smallest of all, and groups of consecutive smallest sums, taken two and two and three and three together, are all either at the beginning or at the ending of the lunation; whilst the largest, and groups of consecutive largest, are between the 8th and 19th days, thus indicating an influence on the fall of rain according to the age of the moon.

By combining these numbers into groups of six or seven days, so that their means corresponded to, at or about, the day of new moon, and at equal intervals of three and a half days, we find that the sums of the falls of rain

			ins.
At or about the day of new moon		was	42·8
„	3½ days old	„	45·0
„	7 „	„	46·2
„	10½ „	„	46·7
„	14 „	„	45·3
„	17½ „	„	45·4
„	21 „	„	44·7
„	24½ „	„	43·5

From these numbers it appears that the fall of rain upon the whole period of fifty-four years has increased from its minimum at or about the day of new moon, to the average when at about 3½ days old, to the greatest at or about the 10th day, then has slightly decreased and to have been nearly constant, but above the

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average, till after the 17th day, has fallen just below the average on the 21st, and then declined in amount to the minimum at the end or beginning of the lunation.

These results are obtained by making use of every fall of rain, large and small, without exception, including those during thunderstorms and those at the meeting of currents of air of different temperatures. Their whole number is not large, and the term of fifty-four years is not of sufficient length to obtain their elimination on every day of the moon's age; and as several of these, even of the heaviest, may accidentally come on the same day of the moon's age, and thus exercise a large and perhaps an undue influence, it seems desirable to ascertain whether their omission would affect the general results just found.

It is necessary, in so doing, to determine arbitrarily what shall be considered such a fall; this cannot be done satisfactorily, because what value soever may be decided upon, there will be some left in nearly approximate, for the retention of which and the exclusion of others of so nearly the same value no good reason can be given.

I have, however, decided upon any fall of 1 inch, or falls exceeding 1 inch; and the following is the list of all such falls:—

List of Days in the Years 1815 to 1868 on which Rain has fallen to the amount of, or exceeding, 1 inch in the day.

[Day of New Moon =0.]

Year.	Date.	Amount. ins.	Moon's Age. days.
1816 ...	June 28	1·32	2
1818 ...	May 10	1·34	4
„ ...	September 26.....	1·30	26
1819 ...	„ 29.....	1·00	10
„ ...	May 5.....	1·10	11
1820 ...	January 20.....	1·13	5
„ ...	May 16	1·10	4
„ ...	July 31	1·51	21
„ ...	September 18.....	1·38	11
1821 ...	June 8	1·17	8
1822 ...	April 16	1·11	24
„ ...	July 5.....	1·40	16
„ ...	October 19.....	1·16	4
„ ...	November 16.....	1·12	3

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List of Days in the Years 1815 to 1868 on which Rain has fallen to the amount of, or exceeding, 1 inch in the Day (*continued*).

Year.	Date.	Amount. ins.		Moon's Age. days.	
1823 ...	January 29.....	1·07	.....	17	}
„ ...	July 25	1·05	.....	17	}
„ ...	October 1	1·15	.....	27	}
„ ...	October 31.....	1·15	.....	27	}
1824 ...	February 14	1·18	.....	14	
„ ...	May 16	1·25	.....	17	
„ ...	August 14	1·63	.....	19	
1825 ...	May 13	1·40	.....	25	
„ ...	September 17.....	1·37	.....	5	
1826 ...	March 7	1·00	.....	10	
„ ...	July 24	1·97	.....	19	
1828 ...	July 22	1·21	.....	10	
„ ...	August 8.....	1·00	.....	27	
„ ...	August 14	1·21	.....	4	
1829 ...	April 9	1·00	.....	6	
1830 ...	June 3	1·38	.....	12	
1831 ...	February 7.....	2·89	.....	24	
„ ...	September 1	1·16	.....	25	
„ ...	September 28.....	1·09	.....	22	
1832 ...	March 14	1·21	.....	12	
„ ...	July 12	1·01	.....	14	
„ ...	October 7	1·47	.....	13	
1833 ...	August 30	1·14	.....	15	
„ ...	December 23	1·10	.....	12	
1834 ...	July 29	1·44	.....	23	
1835 ...	May 13	1·00	.....	16	
„ ...	October 25.....	1·14	.....	3	
„ ...	October 30.....	1·00	.....	8	
1837 ...	January 26.....	1·10	.....	20	
„ ...	August 23	1·10	.....	22	
1838 ...	September 27.....	1·10	.....	9	
1839 ...	November 27.....	1·20	.....	21	
1841 ...	June 24	1·03	.....	5	
„ ...	September 23.....	1·03	.....	8	
„ ...	October 27.....	1·03	.....	13	
1842 ...	August 10	1·10	.....	4	
1843 ...	August 23	2·16	.....	27	

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List of Days in the Years 1815 to 1868 on which Rain has fallen to the amount of, or exceeding, 1 inch in the Day (*continued*).

Year.	Date.	Amount. ins.	Moon's Age. days.
1844 ...	October 15	1·38	4
„ ...	November 8	1·03	28
1846 ...	September 23	1·18	3
1848 ...	June 12	1·43	11
1849 ...	May 28	1·15	6
1851 ...	March 15	1·45	12
„ ...	July 23	1·44	24
1852 ...	June 9	1·36	21
„ ...	July 25	1·99	8
„ ...	August 15	1·08	0
„ ...	October 4	1·01	21
„ ...	November 26	1·00	15
1853 ...	June 13	1·15	7
„ ...	July 14	2·63	8
„ ...	July 28	1·11	22
„ ...	October 27	1·05	25
1854 ...	August 3	1·40	9
1855 ...	July 11	1·42	27
„ ...	July 26	1·15	12
„ ...	October 30	1·06	19
1856 ...	June 20	1·00	18
1857 ...	August 14	1·12	24
„ ...	September 8	1·00	20
„ ...	September 11	1·16	23
„ ...	October 22	2·57	5
1858 ...	June 5	1·16	23
1859 ...	September 26	1·26	0
1861 ...	May 11	1·07	2
„ ...	November 13	1·29	11
„ ...	November 22	1·00	20
1862 ...	April 9	1·10	10
„ ...	August 17	1·27	22
1863 ...	June 19	1·46	3
1865 ...	January 27	1·25	0
„ ...	May 23	1·03	28
„ ...	June 30	1·39	7
„ ...	August 23	1·79	2

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List of Days in the Years 1815 to 1868 on which Rain has fallen to the amount of, or exceeding, 1 inch in the Day (*continued*).

Year.	Date.	Amount. ins.	Moon's Age. days.
1865 ...	October 19.....	1·06	0
„ ...	October 22.....	1·11	3
1866 ...	January 11.....	1·61	24
„ ...	June 4	1·34	21
1867 ...	July 26	3·67	25
1868 ...	January 22	1·21	28
„ ...	May 29	1·08	7

In this list there are ten years (1815, 1817, 1827, 1836, 1840, 1845, 1847, 1850, 1860, and 1864) which do not appear, showing that there was no instance in any of those years in which the daily rainfall amounted to 1 inch.

In the year 1865 there are six instances in which the fall amounted to or exceeded 1 inch.

In the year 1852 there are five such instances.

In the years 1820, 1822, 1823, 1853, and 1857 there are four such instances in each year.

The whole number of such cases in the fifty-four years is 95, or rather more than $1\frac{3}{4}$ fall per year, or, more accurately, 7 such instances in every four years.

Only one instance occurred in which the fall exceeded 3 inches, viz. on July 26, 1867, =3·67 ins.

Four exceeded 2 and were less than 3, one fall occurring in each of the years 1831, 1843, 1853, and 1857; and 90 exceeded 1 and were less than 2 inches.

		ins.
4	occurred on the day of new moon, their sums	=4·65
3	occurred when the moon was 2 days old	=4·18
5	„ „ „ 3 „	=6·01
6	„ „ „ 4 „	=7·29
4	„ „ „ 5 „	=6·10
2	„ „ „ 6 „	=2·15
3	„ „ „ 7 „	=3·62
5	„ „ „ 8 „	=7·82
2	„ „ „ 9 „	=2·50
4	„ „ „ 10 „	=4·31
4	„ „ „ 11 „	=5·20

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						ins.
5	occurred	when	the moon	was	12 days old ...	=6·29
2	„	„	„	13	„ ...	=2·50
	„	„	„	14	„ ...	=2·19
2	„	„	„	15	„ ...	=2·14
2	„	„	„	16	„ ...	=2·40
3	„	„	„	17	„ ...	=3·37
1	„	„	„	18	„ ...	=1·00
3	„	„	„	19	„ ...	=4·66
3	„	„	„	20	„ ...	=3·10
5	„	„	„	21	„ ...	=6·42
4	„	„	„	22	„ ...	=4·57
3	„	„	„	23	„ ...	=3·76
5	„	„	„	24	„ ...	=8·17
4	„	„	„	25	„ ...	=7·28
1	„	„	„	26	„ ...	=1·30
5	„	„	„	27	„ ...	=6·88
3	„	„	„	28	„ ...	=3·27

From this it appears that during the whole of the fifty-four years there was not a single instance of a fall of rain so large as 1 inch in the day in any of the 668 lunations when the moon was one day old; and there was only one such case on the 18th and 26th days of the moon's age; whilst there were six on the 4th day, and five on the 3rd, 8th, 12th, 21st, 24th, and 27th days: the amounts are shown in the last column, and vary from 1 inch on the 18th to 8·17 ins. on the 24th day of the moon's age.

By omitting these several days in each group of nine and eighteen years, the next Table is formed.

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TABLE IV. Amounts of Daily Rainfall in periods of Nine Years and Eighteen Years, omitting all Falls of 1 inch, &c.

Periods.	Age of the Moon in Days.														
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
1815–1823	6·72	7·63	4·40	7·38	5·93	9·16	9·12	6·98	8·27	7·44	7·82	5·15	7·78	10·43	6·92
1824–1832	6·11	9·10	9·07	7·55	8·63	7·84	7·69	6·18	6·49	11·63	5·86	7·23	7·23	4·50	7·71
1833–1841	7·47	7·34	6·58	4·67	7·31	5·19	7·69	9·07	8·47	10·35	7·28	7·18	8·37	7·43	6·40
1842–1850	6·42	6·53	5·08	6·09	6·11	7·69	4·94	4·87	6·19	7·26	5·94	5·12	5·11	5·61	6·43
1851–1859	4·43	6·54	6·36	6·47	4·92	6·03	5·95	4·87	4·09	5·34	5·51	6·72	6·92	4·50	6·70
1860–1868	3·70	7·86	6·01	6·27	5·11	6·70	7·09	6·23	7·69	7·00	5·84	8·48	7·64	7·45	6·86
1815–1832	12·83	16·73	13·47	14·93	14·56	17·00	16·81	13·16	14·76	19·07	13·68	12·38	15·01	14·93	14·63
1833–1850	13·89	13·87	11·66	10·76	13·42	12·88	12·63	13·94	14·66	17·61	13·22	12·30	13·48	13·04	12·83
1851–1868	8·13	14·40	12·37	12·74	10·03	12·73	13·04	11·10	11·78	12·34	11·35	15·20	14·56	11·95	13·56
1815–1868	34·85	45·00	37·50	38·43	38·01	42·61	42·48	38·20	41·20	49·02	38·25	39·88	43·05	39·92	41·02

	Age of the Moon in Days.														
	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
1815–1823	5·12	7·69	7·45	8·33	6·57	6·24	4·26	6·88	6·81	5·23	6·51	6·75	5·72	7·04	3·92
1824–1832	8·92	6·41	8·31	9·37	5·27	6·45	6·57	8·48	8·94	6·93	6·68	4·73	5·36	7·01	5·12
1833–1841	8·30	8·22	5·55	5·52	8·10	7·33	6·86	6·69	5·34	4·49	8·97	9·00	6·62	6·30	3·83
1842–1850	8·05	5·19	5·31	7·18	7·70	5·16	7·13	6·55	6·24	6·71	5·78	5·99	7·10	5·59	3·40
1851–1859	6·88	5·90	8·09	7·68	5·78	7·08	7·53	6·12	4·61	5·96	6·22	6·57	4·86	6·95	3·01
1860–1868	9·08	5·90	8·81	7·61	7·43	7·65	7·59	5·06	6·96	5·45	6·66	6·61	5·23	6·10	4·57
1815–1832	14·04	14·10	15·76	17·70	11·84	12·69	10·83	15·36	15·75	12·16	13·19	11·48	11·08	14·05	9·04
1833–1850	16·35	13·41	10·86	12·70	15·80	12·49	13·99	13·24	11·58	11·20	14·75	14·99	13·72	11·89	7·23
1851–1868	15·96	11·80	16·90	15·29	13·21	14·73	15·12	11·18	11·57	11·41	12·88	13·18	10·09	13·05	7·58
1815–1868	46·35	39·31	43·52	45·69	40·85	39·91	39·94	39·78	38·90	34·77	40·82	39·65	34·89	38·99	23·85

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By combining these numbers, we find that the fall of rain

	ins.
At or about new moon was	38·5
„ „ 3½ days old was	40·7
„ „ 7 „ „	41·4
„ „ 10½ „ „	41·9
„ „ 14 „ „	41·9
„ „ 17½ „ „	42·6
„ „ 21 „ „	40·0
„ „ 24½ „ „	38·1

These numbers are more closely in accordance with each other than those on p. 335, Table III.; but their order of increase from the beginning of the lunation, attaining the maximum at 10½ days, and the decrease to the minimum at the end or beginning of the lunation, are in general agreement with the results found from the use of all the observations; and as I have no certain reason for the omission of the heavy falls, but, on the contrary, think they ought to be included, we may consider (as whether they are used or not, similar results are found) that the moon does exercise an influence on the fall of rain. This result is different from that arrived at by Mr. Dines; but is, notwithstanding, partly confirmed by his own results, for he found

	ins.
That when the moon was 3½ days old, the average fall of rain was	5·922
10½ days old, was	6·071
17½ „ „	6·001
24½ „ „	5·911

the numbers indicating a more flattened curve, but of the same form as that found from this investigation.

So far, this inquiry has been based solely upon the measured amounts of rain fallen, the most important part; but if the moon exercises an influence, it is as likely to exercise it on the frequency of rain as on the amounts. I therefore proceed to make the inquiry based upon the frequency of the falls of rain only.

A Table was formed from the fifty-four Tables, of which that on p. 329 is a specimen, by taking the number of times rain had fallen on every day of the moon's age in each of those Tables; and

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in this way Table V. (pp. 344 and 345) was formed, the top line of which was deduced from the Table on p. 329.

By looking over this Table the numbers appear pretty equally distributed; but those towards the end of the lunation are generally smaller than the others.

In some cases the space is blank, implying that no rain fell on that day of the moon's age during any of the twelve or thirteen lunations in the year; for instance, no rain fell after the 26th day in any of the lunations in the year 1820, and there are several other instances in different years. There are also several cases in which rain has fallen only on one day out of the twelve or thirteen in the year. On the other hand, there are no instances in which rain has fallen on every day in all the lunations in a year: the greatest number is twelve in the year 1848, when the moon was 23 days old; there is only one instance of eleven, viz. in the same year when the moon was 1 day old, and there are several instances of 10 and of 9.

The numbers in the bottom line of this Table (on pp. 346 and 347) show the number of times rain fell out of the 668 days when the moon was of the same age.

The smallest number is on the 24th day, and the next in order of smallness is the 23rd day: the sum of the two smallest consecutive numbers is 460 on the 23rd and 24th; the next in order (not using the 23rd again) is 467, on the 27th and 28th. The sum of the three smallest consecutive is 696, being that of the 22nd, 23rd, and 24th days. The largest number is on the 9th day, viz. 274; the next in order is 272 on the 12th and 18th days. The largest sum of two consecutive days is 541, being that of the 11th and 12th; the next in order is the 8th and 9th, their sum being 537. The largest sum of three consecutive days is 798, being those of the 17th, 18th, and 19th, and the next in order is 796, being those of the 8th, 9th, and 10th.

Thus rain has been least frequent towards the end of the lunation, and most frequent both preceding and following full moon.

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TABLE V. Showing the Number of Times Rain Fell on every Day of

Years.	Age of the													
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1815.	8	6	5	5	6	5	6	9	6	4	4	5	9	6	7
1816.	4	4	4	7	2	5	6	5	8	8	10	7	9	10	9
1817.	8	9	7	6	6	6	5	8	9	8	6	6	7	5	6
1818.	2	4	6	5	7	6	6	8	3	6	4	3	5	5	5
1819.	7	4	5	6	3	5	6	4	3	4	7	7	4	4	5
1820.	2	6	2	1	3	4	4	4	5	6	2	5	2	4	4
1821.	5	7	5	6	4	8	7	4	6	6	7	7	6	3	4
1822.	1	4	4	4	4	4	6	3	4	3	6	2	5	5	5
1823.	3	7	4	3	1	3	3	2	3	2	1	4	1	5	2
1824.	5	4	5	4	6	4	5	3	2	7	5	6	4	4	5
1825.	1	2	3	...	2	3	4	1	4	4	6	1	2	1	5
1826.	4	3	2	2	3	4	4	6	2	4	1	4	3	5	4
1827.	4	3	5	4	5	4	3	1	2	3	4	4	3	1	2
1828.	5	3	6	4	6	3	3	3	3	3	6	5	6	2	3
1829.	3	5	...	2	3	4	3	1	1	4	3	2	3	3	...
1830.	7	4	3	6	5	5	5	8	4	3	2	4	6	3	5
1831.	6	8	8	5	6	4	5	7	5	3	3	7	7	6	6
1832.	4	4	5	4	5	7	7	6	6	5	4	4	6	6	6
1833.	7	4	6	5	6	7	5	5	6	7	4	7	4	6	7
1834.	4	4	3	7	5	5	4	3	4	5	3	2	5	4	6
1835.	7	4	4	3	6	6	8	6	7	5	5	7	5	6	4
1836.	2	4	6	2	3	6	5	4	8	4	7	5	6	3	3
1837.	4	3	3	4	8	2	3	5	3	5	4	4	3	5	3
1838.	4	3	5	4	5	5	7	4	6	7	5	5	6	3	6
1839.	2	3	4	4	5	4	6	7	8	8	5	9	7	6	4
1840.	2	3	6	4	2	4	4	6	3	2	4	3	3	4	5
1841.	5	7	3	5	5	6	7	4	9	7	3	4	6	6	6
1842.	4	5	2	5	4	1	2	4	6	6	5	6	3	8	6
1843.	3	6	2	4	6	4	5	4	6	6	5	6	3	3	4
1844.	3	6	5	5	3	3	1	3	4	5	3	2	3	2	3
1845.	5	3	5	6	4	6	4	5	5	3	3	1	4	4	2
1846.	4	5	4	7	4	5	4	5	3	4	3	4	3	2	2
1847.	3	4	...	5	6	1	3	3	3	2	4	5	2	3	3
1848.	7	11	9	9	5	7	7	9	8	8	8	8	6	7	8
1849.	6	6	4	3	7	7	8	6	5	4	7	5	3	2	4
1850.	5	6	2	3	3	5	5	4	5	6	3	3	2	3	6
1851.	4	4	7	4	4	5	6	4	4	6	4	6	7	5	5
1852.	6	5	5	5	6	5	5	3	4	7	8	6	4	3	3
1853.	7	4	6	6	5	7	5	6	7	5	7	5	8	6	6
1854.	4	7	5	7	6	5	4	4	6	4	5	4	3	2	2
1855.	7	5	4	3	4	5	3	3	3	2	5	6	5	2	6
1856.	4	3	4	5	3	4	6	7	6	7	7	5	8	9	9
1857.	5	4	3	1	3	2	3	4	2	4	4	3	4	3	3
1858.	6	5	3	2	2	2	3	2	3	3	4	3	6	1	2
1859.	3	8	9	8	7	9	6	6	7	8	6	10	7	6	4

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the Moon's Age, in each of the lunations, for the Years 1815–1868.

Moon in Days.														Years.
15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	
6	4	6	7	3	5	8	6	6	5	4	4	5	6	5	1815.
7	6	9	9	7	9	5	4	5	4	5	4	5	7	4	1816.
7	6	6	7	6	7	5	4	4	4	6	6	6	7	3	1817.
4	5	5	7	6	7	4	5	3	4	7	6	4	5	5	1818.
5	5	2	5	3	4	2	3	6	2	4	4	4	8	3	1819.
3	4	4	4	2	3	4	3	4	4	3	2	...	...	...	1820.
4	4	6	4	4	1	2	5	4	5	5	5	8	5	5	1821.
4	6	4	2	2	5	4	6	6	4	4	3	3	5	2	1822.
2	7	5	4	4	4	2	1	3	4	5	5	8	6	4	1823.
5	5	5	6	6	5	5	3	4	6	4	5	3	6	1	1824.
3	1	1	2	3	3	2	4	4	3	5	2	2	1	3	1825.
2	5	5	4	3	4	3	2	4	5	5	3	5	1	2	1826.
1	2	2	3	4	3	4	3	3	2	2	5	3	4	3	1827.
4	1	1	2	4	2	2	4	2	1	4	3	2	4	1	1828.
5	2	6	2	2	3	5	2	4	2	2	2	1	3	2	1829.
6	8	7	3	3	5	5	4	3	6	6	4	5	6	4	1830.
4	5	8	6	4	2	4	5	3	8	6	6	3	6	4	1831.
5	4	5	4	3	...	6	4	5	5	3	...	1	2	2	1832.
6	4	4	5	5	5	3	4	4	7	6	7	6	6	3	1833.
5	3	5	5	7	5	6	4	4	4	3	4	4	2	1	1834.
6	6	7	7	1	4	2	3	4	...	3	3	2	6	3	1835.
5	6	4	2	6	6	4	5	4	3	2	5	2	...	2	1836.
3	5	4	5	2	5	3	4	3	2	6	6	3	4	3	1837.
4	3	3	2	4	3	3	4	1	1	2	3	6	6	3	1838.
6	4	5	6	7	5	7	5	2	2	4	6	5	6	3	1839.
3	4	4	4	5	5	3	8	6	6	3	5	5	4	2	1840.
7	9	4	7	6	5	6	4	5	4	3	5	6	4	4	1841.
7	2	4	5	5	6	6	6	4	3	5	6	5	2	2	1842.
6	6	3	4	4	1	3	5	6	5	2	3	5	2	4	1843.
4	2	1	4	5	3	5	3	5	2	5	4	4	4	2	1844.
4	5	5	5	10	6	3	5	4	4	4	5	3	4	5	1845.
5	5	3	3	4	...	5	2	3	4	5	4	4	7	2	1846.
2	1	5	4	5	...	...	4	4	6	3	3	6	6	2	1847.
7	8	6	6	8	6	7	10	12	9	8	7	7	6	2	1848.
6	4	5	5	4	3	3	5	...	3	4	6	6	6	2	1849.
7	6	6	8	7	5	5	4	6	3	4	3	7	5	3	1850.
5	6	4	6	7	8	5	3	3	4	3	5	5	5	4	1851.
6	4	3	5	3	6	7	6	6	5	6	6	5	3	3	1852.
10	7	6	9	6	7	10	8	6	6	8	7	5	4	3	1853.
4	4	4	4	3	5	6	5	6	5	5	8	6	3	2	1854.
5	4	6	5	4	4	4	4	7	5	7	6	5	5	3	1855.
8	2	4	6	7	4	6	5	2	4	4	5	4	6	3	1856.
6	7	9	6	5	4	4	1	5	2	2	5	...	3	1	1857.
3	4	5	5	2	3	5	2	6	4	4	7	5	5	4	1858.
2	5	7	4	7	5	4	6	3	4	6	7	6	7	4	1859.

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TABLE V. Showing the Number of Times Rain Fell on every Day 1868 (*continued*).

Year.	Age of the														
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1860.	6	10	10	8	8	7	8	7	6	7	6	7	9	6	5
1861.	5	5	10	7	4	7	6	6	4	5	5	6	9	4	6
1862.	4	4	3	4	3	3	8	4	9	9	5	6	8	8	7
1863.	1	3	1	5	6	2	2	2	3	3	4	6	4	3	3
1864.	3	5	4	5	4	5	1	3	2	4	5	2	4	3	5
1865.	5	3	5	4	6	5	3	4	7	7	7	6	5	5	4
1866.	5	7	4	5	4	6	7	5	5	3	5	6	5	6	4
1867.	7	6	6	6	6	9	6	6	5	6	6	8	9	6	5
1868.	7	7	7	6	5	2	2	4	5	7	4	5	5	3	6
Sums	245	269	248	250	250	258	260	250	263	274	259	269	272	236	250

By taking the sum of the numbers in groups of nine and

TABLE VI. Showing the Number of Times Rain Fell on every

Periods.	Age of the														
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1815–1823.	40	51	42	43	36	46	49	47	47	47	47	46	48	47	47
1824–1832.	39	36	37	31	41	38	39	36	29	36	34	37	40	31	36
1833–1841.	37	35	40	38	45	45	49	44	54	50	40	46	45	43	44
1842–1850.	40	52	33	47	42	39	39	43	45	44	41	40	29	34	38
1851–1859.	46	45	46	41	40	44	41	39	42	46	50	48	52	37	40
1860–1868.	43	50	50	50	46	46	43	41	46	51	47	52	58	44	45
1815–1832.	79	87	79	74	77	84	88	83	76	83	81	83	88	78	83
1833–1850.	77	87	73	85	87	84	88	87	99	94	81	86	74	77	82
1851–1868.	89	95	96	91	86	90	84	80	88	97	97	100	110	81	85
Sums	245	269	248	250	250	258	260	250	263	274	259	269	272	236	250

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of the Moon's Age, in each of the lunations, for the Years 1815–

Moon in Days.														Year.
15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	
7	6	6	7	5	7	6	4	5	6	8	7	5	6	4	1860.
5	4	6	5	8	5	6	3	4	5	4	2	4	6	4	1861.
5	3	7	9	7	7	7	5	7	5	2	6	6	2	2	1862.
3	4	4	3	4	9	6	7	3	9	6	6	6	4	1	1863.
6	4	4	6	5	3	6	7	5	3	5	4	6	5	4	1864.
5	5	5	3	6	7	6	3	2	4	5	5	3	5	3	1865.
6	6	7	7	7	7	6	5	4	5	6	8	6	4	4	1866.
7	7	7	9	9	8	5	5	4	5	5	6	3	1	...	1867.
3	2	4	5	4	5	3	4	5	4	4	4	4	3	4	1868.
266	247	263	272	263	249	248	236	233	227	242	258	238	239	154	Sums.

eighteen years, the next Table is formed.

Day of the Moon's Age, in Periods of Nine and Eighteen Years.

Moon in Days.														Periods.
15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	
42	47	47	49	37	45	36	37	41	36	43	39	43	49	31	1815–1823.
35	33	40	32	32	27	36	31	32	38	37	30	25	33	22	1824–1832.
45	44	40	43	43	43	37	41	33	29	32	44	39	38	24	1833–1841.
48	39	38	44	52	30	37	44	44	39	40	41	47	42	24	1842–1850.
49	43	48	50	44	46	51	40	44	39	45	56	41	41	27	1851–1859.
47	41	50	54	55	58	51	43	39	46	45	48	43	36	26	1860–1868.
77	80	87	81	69	72	72	68	73	74	80	69	68	82	53	1815–1832.
93	83	78	87	95	73	74	85	77	68	72	85	86	80	48	1833–1850.
96	84	98	104	99	104	102	83	83	85	90	104	84	77	53	1851–1868.
266	247	263	272	263	249	248	236	233	227	242	258	238	239	154	Sums.

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By collecting the numbers in groups so that the mean shall correspond to 0 days, and at intervals of $3\frac{1}{2}$ days, we find that the sums of the numbers of days on which rain fell

At or about new moon		was	250
„	$3\frac{1}{2}$ days old	„	256
„	7 „	„	259
„	$10\frac{1}{2}$ „	„	262
„	14 „	„	258
„	$17\frac{1}{2}$ „	„	260
„	21 „	„	247
„	24 „	„	239

And these numbers imply that rain is more frequent in the week preceding and that following full moon, and less frequent during the first and last weeks of the lunation, the maximum preceding full moon and the minimum preceding new moon.

Thus, whether we take the amounts of rain fallen or its frequency, both lead to the same conclusion, viz. that the position of the moon with respect to her age does seem to exercise a sensible influence both on the frequency and amounts of rain.

The average amount per fall of rain on every day of the moon's age would be found by dividing the numbers in Table I. by the numbers in Table V., and those for the groups of nine or eighteen years by the corresponding numbers in Tables II. and III. by the numbers in Table VI.

The average amount of rain per fall for each day of the moon's age from all the falls on that day will be found by dividing the whole sum of the falls for each day by the whole numbers of falls for the same day, the following is the result:—

	in.
The average amount of rain per fall on the day of new moon was	0·161
„ „ „ when 1 day old „	0·168
„ „ „ „ 2 „ „	0·168
„ „ „ „ 3 „ „	0·178
„ „ „ „ 4 „ „	0·181
„ „ „ „ 5 „ „	0·189
„ „ „ „ 6 „ „	0·172
„ „ „ „ 7 „ „	0·167
„ „ „ „ 8 „ „	0·186
„ „ „ „ 9 „ „	0·188

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								in.
The average amount of rain per fall when				.....	10	days old	...was	0·164
"	"	"	"		11	"	... "	0·168
"	"	"	"		12	"	... "	0·181
"	"	"	"		13	"	... "	0·180
"	"	"	"		14	"	... "	0·173
"	"	"	"		15	"	... "	0·178
"	"	"	"		16	"	... "	0·169
"	"	"	"		17	"	... "	0·178
"	"	"	"		18	"	... "	0·172
"	"	"	"		19	"	... "	0·173
"	"	"	"		20	"	... "	0·173
"	"	"	"		21	"	... "	0·187
"	"	"	"		22	"	... "	0·184
"	"	"	"		23	"	... "	0·183
"	"	"	"		24	"	... "	0·189
"	"	"	"		25	"	... "	0·199
"	"	"	"		26	"	... "	0·159
"	"	"	"		27	"	... "	0·176
"	"	"	"		28	"	... "	0·177
"	"	"	"		29	"	... "	0·155

From these numbers it appears that the lightest rains occur at about the end and the beginning of the lunation, the heaviest from the 21st day to the 26th, and from the 5th to the 9th day.

The times of heaviest falls are therefore at the times of least frequency of rain, viz. from the 21st to the 26th. By grouping these results, we find that—

								in.
The average amount of rain per fall, when at or near new moon				.....			...was	0·173
"	"	"	"	$3\frac{1}{2}$	days	old	... "	0·176
"	"	"	"	7	"		... "	0·178
"	"	"	"	$10\frac{1}{2}$	"		... "	0·178
"	"	"	"	14	"		... "	0·175
"	"	"	"	$17\frac{1}{2}$	"		... "	0·174
"	"	"	"	21	"		... "	0·181
"	"	"	"	$24\frac{1}{2}$	"		... "	0·182

Therefore the lightest falls are at or near new moon, increasing till the moon is approaching full, then diminishing somewhat, but

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still large; and the heaviest are from the 21st to the 25th days of the moon's age.

The results in this paper are based upon the observations taken on 19,726 days, extending from 1815, January 10 (the day of the first new moon of that year) to 1869, January 12 (the last day of the lunation whose first day was 1868, December 14).

Any results deduced from this long series of observations is certainly entitled to some weight. If the moon's influence be truly such as indicated in this paper, then the same results ought to be found from observations at other places taken over a long series of years and discussed in a similar manner.

With respect to the influence of the moon on the fall of rain, which is connected with her influence on the amount of cloud, Professor Loomis, of Yale College, states that, from seven years' observations at Greenwich, he found the amount of cloud to be the greatest when about 19 days old, and least when 25 days (that is, at the time when the heaviest showers take place and of least frequency), and increasing generally from this day to the maximum, two days before the beginning of the last quarter.

Long series of observations at places influenced by local causes, such as the proximity to mountains, or periodical rains, as in India, are not suited to investigations of this nature; but the results of observations at places inland and free from local disturbances are needed to confirm, or otherwise, the influence of the moon on the fall of rain, as thus indicated.

XXXVIII. *On the Meteorology of Earthquakes.*

By R. J. Mann, Esq., M.D., F.R.A.S., F.R.G.S., &c.

It is a somewhat curious fact that a record of earthquake disturbance is scarcely ever made without a careful and elaborate statement of the direction of the wind, of the character of the clouds, and of the condition of atmospheric pressure and temperature at the time and place where the shock is noticed as having been experienced. The continual recurrence of remarks of this character in the public journals very strikingly and strongly indicates the tendency of the public mind to connect earthquakes, in some way,

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with peculiar states of the atmosphere. Generally the idea seems to be that the earthquake produces some marked effect upon the weather. Immediately after the shock has been experienced, the air is close and sultry, or it is cloudy and moist; occasionally it is even heavy and sulphurous. This, however, is not the only and universal idea of the way in which the atmosphere sympathises with the trembling earth. Sometimes it seems to be rather shrewdly suspected that the relation lies in the opposite direction, and that the earth trembles because the weather is sultry. Thus, in a letter printed in a provincial journal on Saturday the 27th of March last, the writer says, "I have this (Thursday) evening felt a severe shock of earthquake, apparently running from east to west, unaccompanied in my case, and as far as I know in other cases in the neighbourhood, with any sound. *I cannot but ascribe it to the peculiar kind of weather that we had lately.* I allude to the mild winter and almost unparalleled heat of the summer. The time of this earthquake was exactly 25 minutes past 8. P.S. A friend of mine, who has just stepped in, assures me that he, also, has experienced the same sensation."

In this instance it must be felt to be a cause of meteorological regret that the writer does not state why it is that he "cannot but ascribe the severe shock, running from east to west, in his case unaccompanied with sound, to the peculiar weather that had been prevalent of late." If he had done this, meteorologists would have been in a more favourable position, at least for following, if not for appreciating, the views which it is his purpose to suggest. He has not, however, left them entirely without guide to his meaning, for he pointedly says that he "alludes to the mild winter and unparalleled heat of the summer." The meteorologist is therefore here distinctly requested to ascribe a slight vibration of the ground in Lancashire on the 25th day of March in the year 1869 to the very high temperatures of the midsummer months of the year 1868.

This is certainly a very bold stroke of generalization. It may, however, conveniently suggest whether it is in actual reality more bold, as a generalization in time, than that other generalization in space so much more commonly encountered, which seems to hold a slight vibration in the solid substance of the earth caused by some mechanical and physical impact, miles deep in the solid substance, and ordinarily thousands of miles away, responsible for the production of some noteworthy and notable effects in the

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condition of the atmosphere at the remote spot where the tremor of the ground is experienced.

It is, as a matter of course, perfectly intelligible that wherever a free opening is established between heated masses within the shell of the earth and the investing atmosphere, appreciable physical changes are liable to be produced in the air by the agency of the interior masses, and also that the activity and energy of actual eruption of matter and vaporous matter may be quickened or controlled by diminution, or increase, of atmospheric pressure. The popular notion of the fishermen of Stromboli that their volcanic mountain was a weather-indicator, if not a weather-glass, was sanctioned by the scientific authority of Mr. Scrope. It is also within reasonable probability that M. Alexis Perrey's idea that earthquakes occur more frequently in winter than in summer may be due to the more sudden and frequent changes of atmospheric pressure that are then experienced. A sudden diminution of atmospheric pressure upon the earth's surface, amounting to 1 lb. to the square inch, may at times just turn the balance which enables internal pent up force to shatter the earth's rigid shell.

So also in every case in which fissures are produced in the solid rocks of the earth, it is quite conceivable that changes may be effected in the composition and condition of the air surrounding the mouths of the fissures.

In considering this question of the meteorological relations of earthquakes, it must, however, be borne in mind that, excepting in actual volcanic regions, the occurrence of absolute fissure of the earth's crust is a surpassingly rare incident. In the most violent earthquakes it is confined to the focus of the disturbance, and only affects a very narrow area. Thus, in the case of the earthquake at Lisbon in the year 1755, although a superficial area four times as large as Europe was made to quake, the actual shattering and fissuring of the ground was confined to the vicinity of Lisbon, and a few of the neighbouring mountain-chains. Very frequently there is no fissuring of the earth's surface at all, but simply a vibratory movement in the molecules of its substance, originating in some internal shock, and propagated centrifugally to enormous distances. The "wave" of the earthquake is analogous to the wave of a glass plate, or vessel, when it is struck to excite a musical sound. The glass plate is not fractured, unless the blow is an unduly violent one; it merely trembles or quake

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in its own substance, and propagates its own trembling to the elastic air. The shattering of the earth only occurs where the outburst of the shock takes place, or where very energetic vibration passes through consecutive and contiguous layers of substance that have respectively different densities and different elastic powers.

In the vast majority of instances the so-called shock of the earthquake is nothing more than the passage of this thrill through the solid and unbroken rocks of the ground, travelling along, at the rate of some twenty miles per second, through areas as vast as the largest continents. When the "earthquake" is of this character, to look for atmospheric effects of the passing vibration is about as reasonable and as hopeful as it would be to look for change in the weather in St. James's Park, because the kettle-drums of the band of the Horseguards were vibrating in the Palace Parade.

XXXIX. *On the Influence of the Moon upon the Fall of Rain in respect to her Age.* By G. DINES, Esq., F.M.S.

THIS paper, relating to the moon's influence upon the fall of rain, is a continuation of one read before the Society in March 1868. As the subject is now treated in a different manner, and the investigation is of a more complete and extended character, I will, at the risk of some repetition, state the sources from which the information is derived, and the method adopted in preparing the Tables which follow. The Journals from which the rainfall is taken have been kept, one at Cobham, Surrey, the other at the Royal Horticultural Gardens, Chiswick; they both extend over a period of forty years, and the Tables now given commence with the new moon of December 9, 1825, and end December 18, 1865. After taking out the times of new moon during the forty years, the year is divided into twenty-eight portions, and all the new moons which occur on or between the times given in the Tables are grouped together without reference to the years in which they occur; this is done with the intention of making the moon's place in declination in each series nearly the same at the same age.

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The times of new moon occurring at all hours, while the rainfall is entered in the journal each morning, the following rule is adopted; for instance, if the time of new moon occurs between 9 A.M. and 9 P.M. on the 4th day of the month, then the rain which falls between the morning of the 4th and 5th days is taken as the first day's rain; but if the change occurs between 9 P.M. and 9 A.M. in the night of the 4th and 5th days, then the rain which falls between the morning of the 5th and 6th days is taken as the first day's rain. The average time from new moon to new moon being nearly 29 days 12 hours 44 minutes, all of the moons extend to 29, and only a part to 30 days; for this reason, as seen in Tables I. & II., the rainfall of the 30th day is much less than that of any other day, as it really represents the rainfall of little more than half the time included in the other days*.

Table III. is prepared from Tables I. & II.; but the rainfall upon the 30th day is proportionately increased in order to represent the same time as the other days; the 30 days are then divided into four groups of days, arranged in two different ways, as shown by the Table, which gives the comparative rainfall at the different times. In Tables I. & II. the rainfall is given in inches, but in Table III. the average amount of rainfall is taken as 100.

The following is a copy of one of the fifty-six abstracts from which Tables I. & II. are composed, and an example is also given of the manner in which the numbers of Table III. are computed.

* The results given in this paper, if compared with those of March 18, 1868, will be found to agree very nearly; but on looking at the amounts of daily rainfall, some differences will be noticed; they arise probably from the following causes. The rainfall of both papers extends over forty years, but owing to the Chiswick journal commencing one year later than that at Cobham, the years taken are different, the first paper extending over the period 1825–1864, the present paper 1826–1865; in the former paper, for reasons there stated, the rainfall had on some days to be taken approximately, The first paper includes the rainfall of 460 lunations, the present of 495.

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Cobham Rainfall.

Time of New Moon.	Days of the Moon's Age.														
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1826, Jan. 8, 9 39 M....	...	...	...	...	...	...	...	...	...	...	...	...	...	0·05	...
1829, „ 5, 3 52 A....	...	...	...	...	0·07	...	...	0·01	...	0·02	...	...	...	...	...
1832, „ 3, 3 12 A....	...	...	...	...	0·16	...	0·24	0·03	0·05	0·39	0·08	...	...	...	...
1834, „ 9, 11 3 A....	0·13	0·33	0·15	0·12	0·13	0·17	0·35	0·17	...	0·17	0·02	0·09	0·42	0·01	0·01
1837, „ 6, 11 46 A....	...	...	0·02	0·08	...	0·14	0·10	...	...	0·06	0·03	0·01	0·06	0·01	0·08
1840, „ 4, 9 20 A....	...	...	...	...	...	...	...	...	0·06	0·01	0·08	0·23	...	0·23	0·18
1842, „ 11, 4 15 A....	0·16	...	0·13	...	0·02	0·03	...	...	...	...	...	0·05	...	0·14	0·24
1845, „ 8, 7 13 M....	...	...	0·07	0·68	0·09	0·11	0·16	0·01	...	...	0·43	0·69	0·01	...	0·02
1848, „ 6, 0 8 A....	...	0·25	...	...	...	...	...	0·05	0·04	...	0·01	0·45	...	...	...
1850, „ 13, 11 19 M....	...	...	...	...	...	0·35	...	...	...	...	0·04	...	0·12	0·08	...
1851, „ 2, 10 44 M....	0·01	0·33	0·01	...	...	0·05	0·06	0·07	0·10	0·01	0·01	...	...	...	0·16
1853, „ 9, 3 53 A....	0·02	0·19	0·03	0·15	...	0·13	0·10	0·38	...	...	0·15	0·17	0·02	...	...
1856, „ 7, 11 17 A....	...	0·23	...	...	...	...	...	...	0·02	0·03	0·09	0·11	0·08	0·39	0·02
1859, „ 4, 5 26 M....	0·03	...	0·01	0·02	0·01	...	...	...	...	...	...	...	...	0·03	0·01
1861, „ 11, 3 27 M....	...	...	...	...	...	...	...	...	0·09	...	...	...	...	...	...
1864, „ 9, 7 46 M....	...	...	0·02	0·20	0·04	...	...	0·04	0·02	0·02	0·11	0·05	0·02	0·03	0·08
Total	0·35	1·33	0·44	1·25	0·52	0·98	1·01	0·76	0·38	0·71	1·05	1·85	0·73	0·97	0·80

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Cobham Rainfall (*continued*).

Time of New Moon.	Days of the Moon's Age.														
	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1826, Jan. 8, 9 39 M....	0·06	...	...	...	...	...	...	0·01	...	0·02	...	0·09	0·01	0·19	0·02
1829, „ 5, 3 52 A....	...	...	...	...	...	0·23	0·01	0·04	...	...	...	...	...	...	
1832, „ 3, 3 12 A....	...	...	...	...	0·01	...	0·15	...	...	0·12	0·02	...	...	...	0·01
1834, „ 9, 11 3 A....	0·02	0·04	0·07	0·15	...	0·02	...	...	...	...	...	0·07	...	...	
1837, „ 6, 11 46 A....	0·11	0·03	0·41	0·68	0·22	0·04	...	0·11	0·05	0·04	...	...	...	...	
1840, „ 4, 9 20 A....	0·07	0·07	0·08	0·03	0·47	0·06	0·33	0·08	0·12	0·01	0·26	0·07	0·27	0·25	
1842, „ 11, 4 15 A....	...	...	...	0·04	...	0·09	...	0·04	...	...	...	0·12	0·05	0·03	
1845, „ 8, 7 13 M....	...	...	0·07	0·10	0·08	0·24	...	...	...	...	0·08	0·02	...	...	
1848, „ 6, 0 8 A....	...	...	...	...	...	...	...	0·03	0·04	0·26	0·21	...	...	...	0·01
1850, „ 13, 11 19 M....	0·09	0 08	...	0·36	0·01	...	...	0·03	0·04	...	0·04	...	0·08	0·01	0·17
1851, „ 2, 10 44 M....	0·34	...	...	0·45	0·12	...	...	...	...	0·03	0·03	0·16	0·26	0·63	0·07
1853, „ 9, 3 53 A....	...	...	...	0·04	...	...	0·13	...	...	0·01	0·06	0·14	...	...	
1856, „ 7, 11 17 A....	0·10	0·20	0·05	0·13	...	...	...	...	...	...	...	...	0·02	0·01	
1859, „ 4, 5 26 M....	...	...	0·01	0·01	0·34	...	0·10	0·01	0·08	...	0·18	0·15	...	0·05	0·01
1861, „ 11, 3 27 M....	...	...	...	...	...	...	...	...	...	...	0·01	0·01	0·09	0·04	
1864, „ 9, 7 46 M....	...	...	0·03	...	...	...	...	...	...	0·14	...	...	...	...	
Total	0·79	0·42	0·72	1·99	1·25	0·68	0·72	0·35	0·33	0·63	0·89	0·83	0·78	1·21	0·29

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The numbers in Table III. are computed from the above, as follows:—the rainfall on the 30th day is 0·29 inch; this is for nine days only, while all the others represent sixteen days, or the number of lunations comprised in the series; 0·23 inch has therefore been added to the rainfall of the 30th day, for the deficient days, which makes the total on that day 0·52 inch.

Moon's First Quarter, 1–7½ days.	in.	Second Quarter, 7½–15 days.	in.
1st day.....	0·35	Half of 8th day.....	0·38
2nd „	1·33	9th „	0·38
3rd „	0·44	10th „	0·71
4th „	1·25	11th „	1·05
5th „	0·52	12th „	1·85
6th „	0·98	13th „	0·73
7th „	1·01	14th „	0·97
Half of 8th „	0·38	15th „	0·80
	6·26		6·87

Third Quarter, 15–22½ days.	in.	Fourth Quarter, 22½–30 days.	in.
16th day.....	0·79	Half of 23rd day.....	0·175
17th „	0·42	24th „	0·33
18th „	0·72	25th „	0·63
19th „	1·99	26th „	0·89
20th „	1·25	27th „	0·83
21st „	0·68	28th „	0·78
22nd „	0·72	29th „	1·21
Half of 23rd „	0·175	30th „	0·52
	6·745		5·365

	ins.		
First quarter.....	6·26	= 99	As in the first line of Table III.
Second „	6·87	= 109	
Third „	6·745	= 107	
Fourth „	5·365	= 85	

4) 25·240

6·31 the average = 100

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Table I. Cobham.

Time of New Moons.	Number of Lunations.	Days of the Moon's Age.														
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
		ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan. 1 to 13th	16	0·35	1·33	0·44	1·25	0·52	0·98	1·01	0·76	0·38	0·71	1·05	1·85	0·73	0·97	0·80
„ 14 to 26th	17	1·01	0·21	0·19	0·95	0·75	0·32	1·11	1·17	0·57	0·39	0·61	1·33	0·48	1·10	1·28
„ 27 to Feb. 8th	20	1·67	0·92	0·91	0·71	1·88	1·71	1·18	1·77	1·10	0·41	0·73	0·32	0·73	0·71	1·17
Feb. 9 to 21st	16	1·55	0·94	0·19	0·69	0·27	1·05	0·40	1·01	0·61	0·86	0·84	1·18	0·88	0·53	1·82
„ 22 to Mar. 6th	19	0·59	1·14	1·92	0·93	0·89	1·79	0·70	1·21	0·77	0·80	1·28	1·55	1·52	0·84	0·96
Mar. 7 to 19th	17	0·85	0·67	0·44	0·14	0·50	0·66	0·75	0·39	0·22	0·24	1·07	1·51	0·51	0·78	0·13
„ 20 to Apr. 1st	17	0·51	1·07	0·15	0·72	0·54	0·29	0·58	0·96	1·29	2·30	1·23	1·01	0·58	0·62	0·50
Apr. 2 to 14th	18	0·76	0·64	0·98	1·50	2·47	0·95	0·55	1·36	1·11	1·70	0·44	1·59	1·04	0·52	1·62
„ 15 to 27th	18	0·61	1·01	0·45	0·72	1·18	0·38	0·43	0·50	1·21	0·83	1·01	1·41	1·49	0·96	1·02
„ 28 to May 10th	17	1·26	1·50	1·12	0·51	1·58	0·41	1·15	1·44	1·68	1·99	0·44	0·76	0·82	1·41	1·07
May 11 to 23rd	18	0·77	1·24	0·87	1·14	0·29	0·58	1·25	0·95	0·60	0·61	0·81	1·64	1·95	2·07	0·88
„ 24 to June 5th	18	1·35	0·70	1·65	0·45	1·21	0·18	1·48	1·06	1·22	1·27	1·22	1·78	0·72	0·71	0·46
June 6 to 18th	16	0·55	2·27	2·17	0·98	1·54	1·06	0·44	1·17	1·96	1·06	0·87	0·61	0·31	0·48	0·56
„ 19 to July 1st	19	2·50	0·98	2·03	1·64	0·69	1·65	0·86	1·82	1·18	1·69	1·19	1·56	0·83	1·89	0·73
July 2 to 14th	17	0·30	0·98	0·75	0·58	1·58	2·18	1·74	2·04	2·42	2·86	1·27	3·11	2·67	2·01	1·24
„ 15 to 27th	18	0·32	0·81	0·79	1·11	1·18	1·72	2·35	0·30	2·26	2·22	1·73	0·93	1·68	0·18	0·94
„ 28 to Aug. 9th	18	1·72	0·81	0·75	0·56	2·50	2·51	0·25	1·02	0·57	0·75	1·17	0·05	1·82	0·74	0·83
Aug. 10 to 22nd	17	0·64	0·89	2·23	0·98	0·77	0·87	0·51	0·72	0·40	0·58	0·50	1·57	0·75	0·34	0·47
„ 23 to Sept. 4th	19	1·65	1·00	0·70	2·01	0·61	1·36	1·15	0·66	0·80	0·42	0·59	0·76	1·09	1·55	1·24
Sept. 5 to 17th	16	0·57	1·46	2·39	1·07	1·57	1·45	2·30	1·24	0·95	2·98	1·95	1·18	1·55	1·48	2·48
„ 18 to 30th	18	2·32	1·75	1·20	1·10	1·17	2·50	2·31	1·52	1·79	2·47	1·13	1·19	0·66	0·81	0·91
Oct. 1 to 13th	18	1·09	1·46	1·96	2·18	0·65	1·19	1·23	0·62	1·49	1·90	0·89	1·04	1·82	1·50	1·99
„ 14 to 26th	17	1·06	2·16	2·67	2·72	4·96	0·73	1·19	1·60	2·09	2·53	2·28	1·48	2·05	1·52	0·95
„ 27 to Nov. 8th	17	0·82	0·87	0·62	2·34	1·23	1·07	0·44	1·22	1·39	0·83	0·91	2·19	1·02	1·17	1·82
Nov. 9 to 21st	19	2·13	3·02	1·52	2·28	2·03	1·26	1·31	1·21	1·64	1·44	1·31	1·07	1·16	1·26	0·95
„ 22 to Dec. 4th	17	1·44	0·54	0·93	1·56	0·73	1·95	1·19	0·91	1·72	1·06	0·95	0·85	1·04	1·14	0·39
Dec. 5 to 17th	17	1·21	0·84	0·77	0·47	1·00	1·06	0·41	0·85	0·40	1·58	0·87	1·05	1·94	1·63	0·46
„ 18 to 31st	21	0·99	1·61	1·08	0·64	1·05	1·38	0·67	0·76	1·27	0·93	1·21	0·64	1·31	2·22	0·86
Total	495	30·59	32·82	31·87	31·93	35·34	33·24	28·94	30·24	33·09	37·41	29·55	35·21	33·15	31·14	28·53

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TABLE I. Cobham (*continued*).

Times of New Moon.	Days of the Moon's Age.															Daily average.
	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan. 1 to 13th	0·79	0·42	0·72	1·99	1·25	0·68	0·72	0·35	0·33	0·63	0·89	0·83	0·78	1·21	0·29	0·84
„ 14 to 26th	1·52	1·09	0·31	2·39	0·80	1·28	0·62	0·69	0·98	0·89	0·57	0·08	0·85	1·15	0·68	0·87
„ 27 to Feb. 8th	0·50	0·85	0·86	0·47	0·36	1·31	1·47	1·29	0·57	0·97	1·41	1·00	1·69	1·18	0·32	1·02
Feb. 9 to 21st	0·82	0·29	0·45	0·57	0·55	0·98	0·71	0·62	0·22	0·89	0·70	1·02	1·81	0·87	1·24	0·84
„ 22 to Mar. 6th	0·96	0·81	0·77	0·63	0·70	1·55	0·65	0·86	1·20	0·37	0·17	0·60	0·53	0·53	0·29	0·92
Mar. 7 to 19th	1·66	0·70	0·44	0·35	0·95	0·99	1·17	1·49	1·16	1·29	0·72	0·70	0·41	0·41	0·02	0·71
„ 20 to Apr. 1st	0·92	1·16	0·73	0·79	0·42	0·72	1·28	0·40	0·75	0·69	1·54	1·27	0·84	0·33	0·27	0·82
Apr. 2 to 14th	0·27	1·43	1·10	0·91	0·75	1·79	1·43	0·54	1·49	1·44	1·54	0·97	0·64	0·77	0·55	1·11
„ 15 to 27th	2·85	1·49	0·49	0·99	0·39	0·33	1·54	0·57	0·72	1·39	1·56	1·31	1·32	2·34	0·16	1·03
„ 28 to May 10th	0·65	1·65	1·75	1·39	0·34	0·56	1·41	1·65	0·88	1·49	0·66	2·42	0·54	0·74	0·89	1·18
May 11 to 23rd	1·36	0·85	1·52	0·69	2·37	1·32	1·83	1·58	0·45	2·00	1·47	0·46	2·09	2·98	0·10	1·23
„ 24 to June 5th	1·04	0·88	0·93	0·27	0·79	0·47	0·64	1·04	0·34	0·38	0·37	1·45	0·94	1·04	0·66	0·91
June 6 to 18th	1·15	1·10	0·86	0·32	0·50	0·69	1·20	0·02	0·85	0·57	0·65	2·86	2·79	1·47	2·03	1·16
„ 19 to July 1st	1·25	1·44	1·15	0·72	0·37	1·60	1·00	1·02	0·37	1·06	1·35	0·54	1·36	0·75	0·30	1·20
July 2 to 14th	1·46	2·22	2·12	1·23	1·18	0·30	0·73	1·83	0·59	1·31	1·21	0·44	1·82	0·27	0·63	1·47
„ 15 to 27th	0·83	1·29	0·73	0·87	2·50	1·76	2·33	0·60	3·53	2·07	2·40	2·22	2·24	2·80	0·89	1·56
„ 28 to Aug. 9th	2·58	0·93	0·22	2·13	3·06	1·47	2·59	1·76	1·48	3·18	1·27	1·32	0·91	2·30	1·10	1·44
Aug. 10 to 22nd	1·52	2·14	0·49	1·36	1·14	0·84	1·25	2·05	1·61	1·54	1·35	0·51	0·45	1·16	0·28	1·00
„ 23 to Sept. 4th	1·79	2·48	0·84	2·41	1·77	1·23	0·82	1·42	1·39	0·95	1·29	1·53	0·90	1·57	0·22	1·22
Sept. 5 to 17th	0·57	1·03	2·52	0·85	1·14	2·93	1·28	1·00	1·16	1·92	2·04	2·03	1·87	1·41	0·11	1·55
„ 18 to 30th	0·91	1·26	1·93	1·27	2·79	2·84	1·06	0·81	1·27	1·54	2·61	2·85	0·99	3·30	1·81	1·72
Oct. 1 to 13th	0·57	1·33	1·22	3·16	1·55	2·93	1·73	1·19	0·89	0·76	2·10	0·79	0·91	1·25	0·15	1·39
„ 14 to 26th	0·77	0·89	0·92	1·16	1·01	0·20	1·44	0·28	1·01	0·51	0·76	0·71	0·58	0·66	0·74	1·40
„ 27 to Nov. 8th	0·75	1·15	1·16	1·27	1·42	2·01	2·48	1·40	1·07	1·45	1·00	0·81	1·00	0·97	0·92	1·25
Nov. 9 to 21st	2·61	1·75	1·89	0·61	1·32	1·60	1·22	1·30	1·08	0·92	1·07	1·24	0·51	1·07	0·62	1·43
„ 22 to Dec. 4th	1·19	0·17	0·02	0·54	1·02	0·97	0·78	0·11	0·78	0·61	0·07	0·29	0·15	0·50	0·95	0·83
Dec. 5 to 17th	1·57	0·73	2·14	0·38	0·33	1·13	0·75	0·53	0·37	0·29	0·17	0·96	1·38	0·84	0·59	0·90
„ 18 to 31st	2·44	1·04	1·33	0·39	1·00	0·99	2·42	2·71	1·09	1·07	2·98	0·90	1·70	2·37	0·52	1·33
Total	35·30	32·57	29·61	30·11	31·77	35·47	36·55	29·11	27·63	32·18	33·92	32·11	32·00	36·24	17·33	32·33

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Table II. Chiswick.

Times of New Moon.	Number of Lunations.	Days of the Moon's Age.														
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
		ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan. 1 to 13th	16	0·23	1·20	0·55	1·11	0·42	0·91	0·92	0·61	1·25	0·70	0·93	1·64	1·08	0·86	1·03
„ 14 to 26th	17	0·71	0·24	0·15	0·90	1·18	0·28	1·10	1·00	0·29	0·45	0·71	0·80	0·71	1·00	1·16
„ 27 to Feb. 8th	20	1·80	0·90	1·06	0·78	1·38	1·94	0·92	1·24	0·90	0·53	0·48	0·30	0·68	0·70	1·18
Feb. 9 to 21st	16	1·09	0·93	0·16	0·61	0·53	1·16	0·54	0·76	1·53	0·70	0·81	0·81	0·91	0·37	1·41
„ 22 to Mar. 6th	19	0·79	1·18	2·11	0·84	0·74	1·53	0·64	0·79	0·92	0·67	1·38	1·28	1·74	0·72	1·11
Mar. 7 to 19th	17	0·98	0·70	0·15	0·12	0·55	0·54	0·78	0·19	0·30	0·33	1·02	1·41	0·42	0·81	0·13
„ 20 to Apr. 1st	17	0·26	1·04	0·34	0·97	0·67	0·30	0·37	1·15	1·03	3·56	1·70	0·58	0·46	0·22	0·30
Apr. 2 to 14th	18	0·54	0·53	0·66	1·41	1·71	1·36	0·54	1·09	0·83	1·48	0·32	1·08	1·26	0·65	1·38
„ 15 to 27th	18	2·17	1·19	0·91	0·53	0·52	0·39	0·22	0·56	0·64	1·36	1·25	1·31	1·40	1·00	1·14
„ 28 to May 10th	17	1·39	1·86	0·64	0·99	1·04	0·68	1·76	1·48	1·62	1·57	0·88	0·79	0·52	0·94	0·90
May 11 to 23rd	18	1·39	1·19	0·46	0·99	0·26	0·55	1·21	1·35	0·83	0·41	1·29	1·27	1·57	1·03	1·44
„ 24 to June 5th	18	2·06	0·47	2·02	0·70	1·46	0·24	1·06	1·15	1·58	1·86	1·30	2·12	1·03	1·00	0·69
June 6 to 18th	16	0·63	1·45	1·86	1·57	1·22	1·07	0·59	1·04	2·16	1·76	1·23	0·21	0·83	1·14	0·50
„ 19 to July 1st	19	1·98	0·64	2·33	1·86	1·25	1·20	1·53	1·46	1·37	1·91	1·24	1·29	1·09	1·24	1·45
July 2 to 14th	17	1·69	0·61	1·04	1·34	0·36	2·24	1·78	1·95	1·69	1·91	0·76	2·45	3·57	1·17	1·06
„ 15 to 27th	18	0·45	1·35	0·73	1·04	2·02	2·26	2·96	0·82	1·23	3·33	2·58	0·94	1·74	0·83	0·19
„ 28 to Aug. 9th	18	2·02	2·07	2·11	0·53	1·90	1·13	0·19	1·48	1·04	1·16	1·22	0·37	1·80	0·59	0·35
Aug. 10 to 22nd	17	0·38	1·21	2·04	1·47	0·87	0·91	0·85	0·73	0·80	0·65	0·24	1·58	0·83	0·48	0·80
„ 23 to Sept. 4th	19	1·94	0·82	1·64	2·79	0·97	1·39	1·27	0·51	0·64	0·49	1·17	1·31	0·83	2·40	0·82
Sept. 5 to 17th	16	0·65	2·20	1·29	1·45	1·74	1·21	2·23	1·26	0·70	2·14	1·72	0·92	1·51	1·68	1·41
„ 18 to 30th	18	2·41	1·88	0·99	1·76	1·10	3·10	2·13	1·44	0·78	2·71	1·10	1·28	1·28	0·76	1·13
Oct. 1 to 13th	18	1·45	1·83	2·14	1·67	0·60	1·77	1·37	0·51	1·30	2·48	0·88	1·33	1·63	0·75	2·39
„ 14 to 26th	17	0·82	2·15	2·22	2·01	4·57	0·58	0·91	1·83	2·46	2·65	1·82	0·98	1·81	2·02	0·95
„ 27 to Nov. 8th	17	0·88	0·79	0·84	1·95	1·55	0·81	0·31	1·03	1·15	0·56	0·80	2·07	1·48	1·18	1·56
Nov. 9 to 21st	19	2·55	3·11	1·69	2·30	1·81	1·06	1·05	1·18	1·81	1·52	1·03	1·50	1·01	1·40	0·96
„ 22 to Dec. 4th	17	1·40	0·40	0·81	1·72	0·89	1·58	1·00	0·63	1·05	1·05	0·88	0·87	0·98	1·01	0·53
Dec. 5 to 17th	17	0·93	1·00	0·33	0·54	0·95	1·08	0·33	0·73	0·18	1·58	0·54	1·07	1·91	1·50	0·45
„ 18 to 31st	21	1·07	1·31	0·99	0·57	1·15	1·20	0·66	0·89	1·31	0·58	0·78	0·80	1·01	1·78	2·31
Total	495	34·66	34·25	32·26	34·52	33·41	32·47	29·22	28·86	31·39	40·10	30·06	32·36	35·09	29·23	28·73

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TABLE II. Chiswick (*continued*).

Times of New Moon.	Days of the Moon's Age.															Daily average.
	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ns.
Jan. 1 to 13th	1·37	0·41	0·75	2·17	1·07	0·50	0·72	0·25	0·43	0·07	0·42	0·89	0·68	0·76	0·28	0·81
„ 14 to 26th	1·86	0·77	0·17	1·08	2·12	1·20	0·99	0·59	1·23	0·66	0·38	0·10	0·77	0·85	0·49	0·82
„ 27 to Feb. 8th	0·26	0·82	0·80	0·47	0·79	0·62	2·02	1·48	0·68	0·84	1·35	0·64	1·32	1·20	0·20	0·95
Feb. 9 to 21st	0·98	0·27	0·54	0·78	0·40	0·91	1·00	0·38	0·52	0·84	0·81	0·97	1·77	0·69	0·53	0·80
„ 22 to Mar. 6th	1·15	1·23	0·49	0·62	0·90	1·92	0·38	0·64	1·67	0·21	0·23	0·53	0·43	0·61	0·09	0·92
Mar. 7 to 19th	1·86	0·85	0·36	0·40	1·10	1·15	1·85	1·27	0·91	1·02	0·67	0·81	0·37	0·64	0·06	0·73
„ 20 to Apr. 1st	0·62	0·68	0·36	0·62	0·55	0·93	0·94	0·54	0·58	0·34	1·52	0·76	1·09	0·34	0·56	0·79
Apr. 2 to 14th	0·24	1·33	1·26	0·55	1·02	1·87	1·82	0·70	0·76	1·46	1·64	1·39	0·48	0·59	0·32	1·02
„ 15 to 27th	2·29	1·19	0·77	0·91	0·55	0·33	2·21	0·72	0·99	0·86	1·21	1·42	1·71	1·98	0·22	1·08
„ 28 to May 10th	1·19	1·09	1·55	1·05	0·24	0·75	1·55	1·59	1·29	1·27	0·58	0·64	0·75	0·82	0·67	1·10
May 11 to 23rd	1·10	0·68	0·92	0·53	1·99	1·57	3·40	0·44	2·00	0·94	1·12	1·33	1·90	2·19	0·21	1·19
„ 24 to June 5th	0·90	0·91	1·02	0·30	1·01	0·26	0·46	1·71	0·38	0·48	0·49	1·46	1·03	1·07	0·58	1·04
June 6 to 18th	1·13	1·39	1·00	0·45	0·67	0·82	1·80	0·05	0·58	0·50	0·47	1·04	2·82	1·78	2·33	1·20
„ 19 to July 1st	1·36	1·50	1·41	0·44	0·19	1·40	1·06	1·21	1·52	1·31	1·44	1·93	0·52	0·99	0·23	1·29
July 2 to 14th	1·44	1·80	2·06	1·24	1·49	0·56	1·93	1·92	1·09	1·88	1·62	1·07	0·67	0·18	0·74	1·49
„ 15 to 27th	1·58	1·07	0·48	1·33	2·54	1·88	1·59	0·89	2·61	1·83	2·88	1·18	1·50	2·72	0·88	1·62
„ 28 to Aug. 9th	2·32	2·13	0·29	1·82	2·24	1·62	1·79	1·78	1·14	1·98	1·95	1·53	0·95	2·38	1·04	1·46
Aug. 10 to 22nd	1·66	1·69	0·98	1·69	1·23	1·18	1·13	1·74	2·01	1·02	1·86	1·29	0·13	1·04	0·26	1·10
„ 23 to Sept. 4th	1·56	1·96	0·99	1·42	1·96	0·94	0·81	1·40	1·09	0·95	1·22	1·72	0·73	1·44	0·42	1·27
Sept. 5 to 17th	1·45	0·66	2·25	1·40	1·28	3·24	1·99	1·06	1·25	1·81	1·94	1·45	1·36	1·05	0·06	1·48
„ 18 to 30th	0·63	1·14	1·97	1·19	2·71	2·51	0·54	0·96	0·88	1·34	2·60	2·70	0·97	3·01	1·72	1·67
Oct. 1 to 13th	0·47	1·13	1·35	2·75	1·90	2·36	2·12	1·39	0·70	1·13	1·70	0·93	1·27	1·16	0·24	1·44
„ 14 to 26th	0·51	0·84	1·14	1·10	0·71	0·16	1·23	0·42	0·62	0·89	1·05	0·26	0·51	0·75	0·86	1·31
„ 27 to Nov. 8th	1·29	0·58	1·53	1·10	1·55	2·56	1·72	0·86	0·83	1·36	0·73	0·63	0·40	1·66	0·22	1·14
Nov. 9 to 21st	2·35	1·38	1·55	0·81	1·09	1·74	1·25	1·39	0·93	0·86	1·10	0·74	0·55	1·03	0·57	1·39
„ 22 to Dec. 4th	0·94	0·33	0·18	0·66	0·67	1·23	0·63	0·33	0·95	0·25	0·11	0·03	0·21	0·40	0·47	0·75
Dec. 5 to 17th	1·23	0·69	1·59	0·30	0·48	1·25	0·49	0·46	0·47	0·21	0·42	0·79	0·92	0·61	0·57	0·79
„ 18 to 31st	2·01	0·62	1·03	0·15	0·46	1·17	1·99	2·89	0·97	1·08	2·15	0·77	1·70	1·59	0·50	1·20
Total	35·75	29·14	28·79	27·33	32·91	36·63	39·41	29·06	29·08	27·39	33·66	29·00	27·51	33·53	15·32	31·83

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TABLE III. Cobham (average taken as 100).

Times of New Moon.	First quarter, 7½ days (1–7½ days).	Second quarter, 7½ days (7½–15 days).	Third quarter, 7½ days (16–22½ days).	Last quarter, 7½ days (22½–30 days).	Time of New Moon, 8 days (27–30 and 1–4 days).	Time of First quarter, 7 days (5–11 days).	Time of Full Moon, 8 days (12–19 days).	Time of Last quarter, 7 days (20–26 days).
Jan. 1 to 13th	99	109	107	85	100	93	124	83
„ 14 to 26th	78	97	128	97	84	82	138	97
„ 27 to Feb. 8th	129	79	85	106	106	122	70	103
Feb. 9 to 21st	89	114	74	123	136	86	97	80
„ 22 to Mar. 6th	124	120	94	62	90	115	109	85
Mar. 7 to 19th	79	87	132	103	64	76	106	155
„ 20 to Apr. 1st	70	130	101	99	81	124	95	100
Apr. 2 to 14th	102	105	96	97	81	110	95	115
„ 15 to 27th	65	106	108	121	101	77	131	91
„ 28 to May 10th	93	100	97	110	109	105	101	85
May 11 to 23rd	72	98	116	114	100	59	112	129
„ 24 to June 5th	111	116	81	91	121	121	94	64
June 6 to 18th	111	74	67	148	183	102	59	56
„ 19 to July 1st	125	111	89	74	110	109	100	81
July 2 to 14th	83	150	92	75	59	136	136	69
„ 15 to 27th	72	86	91	150	97	106	59	138
„ 28 to Aug. 9th	89	60	128	123	89	86	80	145
Aug. 10 to 22nd	96	66	130	108	91	62	108	139
„ 23 to Sept. 4th	97	74	132	97	102	67	126	105
Sept. 5 to 17th	98	113	93	96	88	114	93	105
„ 18 to 30th	102	75	97	126	122	107	65	107
Oct. 1 to 13th	96	105	125	74	90	82	114	114
„ 14 to 26th	155	131	62	52	103	157	87	53
„ 27 to Nov. 8th	85	106	117	91	90	81	105	124
Nov. 9 to 21st	132	88	109	70	112	103	99	86
„ 22 to Dec. 4th	141	122	76	61	101	145	80	74
Dec. 5 to 17th	92	124	109	75	103	100	140	57
„ 18 to 31st	78	88	109	124	96	78	96	131
Total	98·93	100·31	101·44	99·32	100·42	100·64	98·82	100·12

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TABLE III. (*continued*) Chiswick (average taken as 100).

Times of New Moon.	First quarter, 7½ days (1–7½ days).	Second quarter, 7½ days (7½–15 days).	Third quarter, 7½ days (16–22½ days).	Last quarter, 7½ days (22½–30 days.	Time of New Moon, 8 days (27–30 and 1–4 days).	Time of First quarter, 7 days (5–11 days).	Time of Full Moon, 8 days, (12–19 days).	Time of Last quarter, 7 days (20–26 days).
Jan. 1 to 13th	92	128	116	63	92	102	15	61
,, 14 to 26th.....	83	92	139	87	73	87	15	125
,, 27 to Feb. 8th	132	76	92	101	107	110	8	117
Feb. 9 to 21st	90	115	84	111	110	108	5	87
,, 22 to Mar. 6th	119	119	102	60	90	104	114	92
Mar. 7 to 19th	72	82	151	94	66	73	106	155
,, 20 to Apr. 1st	76	142	83	99	89	156	59	96
Apr. 2 to 14th.....	95	99	111	95	75	101	96	128
,, 15 to 27th.....	77	103	106	113	124	66	117	92
,, 28 to May 10th.....	110	96	99	94	99	117	91	94
May 11 to 23rd.....	75	95	116	114	104	70	89	137
,, 24 to June 6th	110	130	73	87	119	119	96	66
June 6 to 18th.....	99	93	81	126	162	109	70	59
,, 19 to July 1st	119	107	82	92	105	110	95	90
July 2 to 14th.....	90	122	103	86	73	102	124	101
,, 15 to 27th.....	92	93	90	125	83	132	62	123
,, 28 to Aug. 9th	98	67	120	116	115	79	83	123
Aug. 10 to 22nd	98	70	127	105	91	66	111	132
,, 23 to Sept. 4th	116	83	108	93	120	73	112	95
Sept. 5 to 17th.....	103	96	115	86	80	105	94	120
,, 18 to 30th.....	113	78	89	120	126	106	70	98
Oct. 1 to 13th.....	103	102	119	76	96	89	103	112
,, 14 to 26th.....	145	139	60	56	94	162	89	55
,, 27 to Nov. 8th	90	109	126	75	83	78	118	121
Nov. 9 to 21st	136	94	104	65	116	98	99	87
,, 22 to Dec. 4th	145	119	86	50	94	135	92	79
Dec. 5 to 17th	93	128	105	74	93	98	140	69
,, 18 to 31st	82	100	99	119	93	78	101	128
Totals	102·73	101·12	102·42	93·70	99·95	101·12	96·65	102·27

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A few of the most prominent points in the different Tables may now be noticed. In Tables I. & II. the rainfall on the 10th and 22nd days of the moon's age is in excess of all other days; this agrees with the result obtained in my former paper; but on looking down the columns under those days, and taking the numbers singly, it will be seen how much they vary, and that they are almost as frequently below as above the average.

Table III.—The difference of the totals at Cobham in each of the four quarters of the moon is very slight (not amounting to $1\frac{1}{2}$ per cent. above or below the average); and coupling with this the numbers given in my former paper, where, although nearly equal, those of the first twenty years were opposed to the twenty years following, it might be assumed that the rainfall in each quarter is equal; but at Chiswick the results are very different, the rainfall of the last quarter being $6\frac{8}{10}$ per cent. below the average, whilst all the others are above.

The total rainfall at both places, taking the times of new and full moon together, is less than at the times of first and last quarter; but at Cobham the difference is slight, not exceeding $\frac{3}{4}$ per cent., while at Chiswick it is $3\frac{1}{3}$ per cent. above or below the average. But the numbers of which these totals are composed are of the most perplexing character, no regularity is to be seen in any part, and the results given by the two places are in many cases opposed to each other: it may therefore be interesting to notice in what order the four numbers most frequently occur; as they amount to a fixed sum (400), they can never be all above or all below the average, and there are only fourteen ways in which they can be combined, as shown in the following Table; the positive sign there represents the place of the numbers which are above the average, and the negative sign those which are below: the places given by the totals are shown by the dark lines across each column; as an example, take the third combination + + − −, opposite to which, in the first column, is placed the figure 6, signifying that the rainfall has been above the average during the first and second quarters, and below during the third and last quarters six times; on looking to Table III., it will be seen that this was the case during the time that new moon commenced from February 22 to March 6, April 2 to 14th, May 24 to June 5th, June 19 to July 1st, October 14 to 26th, and November 22 to December 4th, six times. Where the number 100 occurs, I have referred to my

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calculations to see if it represents a number a little above or below, and placed it accordingly.

TABLE IV.

No.	Place of Numbers above or below the average, as they occur in the four divisions of Table III.	Cobham.		Chiswick.	
		First, Second, Third, and Last quarters.	Times of New Moon, First quarter, Full Moon, and Last quarter.	First, Second, Third, and Last quarters.	Times of New Moon, First quarter, Full Moon, and Last quarter.
1.	+++−	.....	2	2	.....
2.	++−+	.....	2	.....	1
3.	++−−	6	5	4	5
4.	+−+−	1	3	3	2
5.	+−−+	3	.....	2	2
6.	+−−−	.....	1	1	1
7.	+−++	.....	1	.....	.....
8.	−++−	5	2	4	2
9.	−+−+	2	4	2	3
10.	−+−−	2	.....	1	4
11.	−+++	1	.....	1	1
12.	−−+−	2	1	3	1
13.	−−−+	1	2	2	.....
14.	−−++	5	5	3	6
	Totals.....	28	28	28	28

From this it will be seen that the combinations nos. 8 and 14, which occur the most frequently, are the opposites of each other, and that neither of them agree with the places given by the totals.

It may be mentioned here that the difference of rainfall at the two places, during the forty years over which these Tables extend, is only 13·83 inches, and that this difference seems entirely owing to the deficiency in the rainfall which occurs at Chiswick during the last six days of the moon's age; on every one of those days the rainfall is less there than at Cobham.

The abstracts from which the Tables in this paper are composed extend over two periods of nineteen years, at the end of which time the sun and moon are again nearly in the same position, with regard to the stars and to each other; there does not appear

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to be any similarity in the rainfall of the two periods; but this point, with the number of rainy days, and also the times of heavy rain, as compared with the moon's age, is reserved for future investigation.

Looking at the great influence which the moon has upon the tides of the ocean, it seems natural that it should also exercise some influence upon the rainfall; and it is a matter of some difficulty to bring the mind to any other conclusion. I have in this paper endeavoured to give ample details; in order that the Fellows of this Society may form their own opinion upon the matter I will only say that throughout this long but not tedious investigation I have failed to discover the slighest connexion between the fall of rain and the moon's changes: it must not, however, be understood by this that great changes do not occur at the times of new and full moon; but they occur quite as frequently at other times. I am therefore, notwithstanding a strong prejudice to the contrary, obliged to come to the conclusion expressed in my former paper, "*that the fall of rain is in no way influenced by the changes of the moon or the moon's age.*" This opinion is formed not so much from the totals of any particular period of years, as from the very different and often contradictory results obtained from the examination of the rainfall for different times and at different places.

XL. *On the Rainfall of Mauritius.* By M. Connal, Esq., C.E. (Communicated by Prof. Newton.)

The Meteorological Society of Mauritius have continuous records of the rainfall, as recorded by the Observatory rain-gauge at Port Louis, from the 1st January, 1853, to the present time —about fourteen years. They have also the continuous record, from the 1st of July, 1862, to the present time, for eight different private gauges—about six years. Further, they possess the record for thirteen other private gauges for various later and consequently shorter periods. In all, record is possessed, for one period or another of time, of twenty-two gauges scattered over the island.

These records have been subjected to various methods of scrutiny in the hope of eliciting general laws.

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1st. A diagram has been constructed showing the annual rainfall for each of the various gauges since its establishment.

2nd. A diagram on a large scale has been constructed showing the monthly rainfall of the various private gauges and that of the Observatory since the establishment of the former in 1862.

3rd. The *law of fluctuation* has been discussed, from the results given by each of the nine elder gauges, that is, the most probable values of the constants in the periodic series

$$E=A+B_1 \sin(\theta+C_1)B_2 . \sin(2\theta+C_2)+, \&c.$$

have been determined this has been done by Bessel's method, the results are given in Appendix A.

An inspection of the diagrams will point out, unmistakably, the existence of the two following general rules:—

1st. A rise or fall for one gauge is accompanied by a rise or fall in all the gauges.

2nd. Each gauge in rising or falling does so with an intensity peculiar to itself, so that their relative order is always the same.

The discussion of the records of the nine elder gauges has led to the knowledge of an empiric expression for the rainfall generally of Mauritius: this formula is given in Appendix B, and the following are the conclusions derived from it, expressed in common language.

Premising that "the wet season" means a period of the year in which the intensity of the rainfall is above the annual average, and, similarly, "the dry season" means a period of the year in which it is below the average, further that, although the language used throughout will be that of *certainty*, yet it must be always understood this is done simply to avoid repetition, that the dates given are not absolutely the correct, but only the most probable ones, that each event which is spoken of as if it would certainly happen on a given date, in reality will fluctuate before and after that date. The amount of this fluctuation will not be the same for all the cases, each will have a "probable error" peculiar to itself.

As before stated, all the gauges have a certain similarity in their fluctuations throughout the year; but the cause or causes which elevate any gauge in the scale of annual downfall, at the same time depress it in the scale of distinctness of seasonal change; the gauges with small annual rainfall are the most marked in showing seasonal change. For example, at the observatory of

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Petite Rivière 74 per cent. of all the rainfall occurs during the wet season ($\frac{3}{4}$ of the year), while at Beau Séjour, with $2\frac{1}{3}$ times more rain, only 63 per cent. falls in that time; and the cause which makes $4\frac{1}{4}$ times more rain fall at Cluny has reduced the rainy-season percentage to 56.

In Appendix C is given the relative mean annual rainfall for the different gauges, the observations being taken as unity. It will be seen that this ranges from 1 to 5 times that of the Observatory. My impression is that $2\frac{1}{4}$ times that of the Observatory would be a rough approximation to the mean of the whole island; this would give 68 inches for Mauritius for the five years ending 31st of December, 1866.

All over Mauritius there is but one wet season and one dry, having the same dates of change.

The wet season commences on the 2nd of December and terminates on the 24th of April, the intensity attaining a maximum on the 12th of February.

The dry season commences on the 24th of April and terminates on the 2nd of December; the intensity is a minimum twice in that period, viz. on the 22nd of June and 4th of October, the latter being the driest day of the year: between these two dates the intensity of the rainfall has a rise, attaining a maximum (which, however, does never attain that of the mean of the year) on the 28th of July.

The general order of the months in regard to wetness is as follows:—

Wet Season.		*Dry Season.*	
February	1	May	6
January	2	November	7
March	3	July, August (equal)	8, 9
December	4	June	10
April	5	September, October (equal)	11, 12

An examination of the annual curve diagram will unmistakably indicate that since 1852 up to November 1867 there has been a gradual diminution of rainfall*; but whether this diminution is one peculiar to the island, or a general one which it shares in

* 1865 had the wet season proper to itself and also that in 1866 in its record.

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common with the surrounding tract of ocean, cannot be decidedly ascertained; in the latter case, a resumption of rainfall may fairly be looked for, but not so certainly in the other cases.

That the change is a general one and not peculiar to the island only, seems to me most probable from the fact that Flat Island gauge, which may probably be taken as the rain-exponent of the surrounding ocean, did not indicate in 1862 and 1863 an intensity very different from that of the Observatory and Petite Rivière (unfortunately we have only two years' record of this very important gauge) the figures stand as follows :—

	1862. ins.		1863. ins.
Flat Island	28·02	.....	36·54
Observatory.....	28·40	.....	33·42
Petite Rivière	25·35	.....	33·35

I cannot detect with certainty any change in the order of intensity among the gauges; true the record is only for a short period, but still I think a very marked change would have had time to show.

The fact of districts being now complained of *as too dry for cane growth* where positively there is still a rainfall *above that which other* districts, where *once the cane* was *cultivated* with *perfect success*, ever conceivably could have had (take the case of Beau Séjour and Gros Cailloux), seems to me to suggest grave doubts as to whether diminution of rainfall be the true cause of the cane-growth decay.

It is universally admitted that *diminution of dampness* in the atmosphere is one of the most immediate apparent effects of forest destruction. May it not be that to this cause we must look for the cane-growth decay? If such be the cause, then obviously forest-planting in the immediate vicinity of cane-fields, not *summit forest-planting* alone, would be the appropriate remedy, and it would be to the individual interests of every planter, who had an estate going out of cultivation from "dryness," immediately to commence reforesting a portion of his land.

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Appendix A.

Table giving the most probable values of the constants in the periodic series

$$E = A + B_1 \sin(\theta + C_1) + B_2 \sin(2\theta + C_2) +, \&c.$$

for the nine elder gauges, as derived from the observations ending 31st of December, 1866.

θ being the sun's longitude, measured from the middle of December.

Stations.		A.	B_1.	C_1.	B_2.	C_2.
		°	°	°	°	°
Five years ending December 31, 1866.	Observatory ...	2·53	2·41	+32·17	1·48	−12·59
	Petite Rivière...	2·33	2·28	28·24	0·88	40·59
	Les Rochers ...	4·18	3·45	27·35	1·47	19·47
	Mon Choisy ...	4·29	3·39	28·58	1·36	15·00
	Labourdonnais	5·30	3·70	28·08	1·30	0·16
	Brae-vacoas ...	5·64	4·28	30·40	1·73	42·42
	Lucia	5·68	3·18	30·09	1·15	10·27
	Beau Séjour ...	5·92	4·53	33·49	1·56	14·35
	Cluny	11·90	5·47	+25·29	2·12	−23·50

Appendix B.

From the discussion of the results of the nine elder gauges, which are given in Appendix A, the following empiric expression for the intensity of the rainfall in Mauritius has been obtained:—

Intensity.—

$$E = A_0\{M + M^{\frac{1}{2}} \sin\theta + 0{\cdot}4M^{\frac{1}{2}} \sin 2(\theta - 40°)\}. \quad \ldots\ldots\ldots \quad (1)$$

E denotes the intensity of the rainfall estimated by the month.

Notation.—M is the modulus of the gauge in question; it is obtained by dividing its rainfall for any number of complete cycles (years) by the Observatory rainfall for the same period of time. [The modulus of a gauge can be deduced from incomplete cycles, but the process is more troublesome. See investigations further on.] M is a function of altitude, exposed to S.E. trade wind and many other circumstances, one of which may possibly be the prevalence of forest in the vicinity of the gauge. In Appendix D, the values of M for a number of gauges is given.

A_0 denotes the Observatory mean intensity (reckoned by the month) for the year in question; it is the Observatory monthly rainfall, on the supposition that the quantity which fell during the year did so uniformly.

θ is the sun's longitude measured from the middle of November.

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Quantity in a given period.—From (1) an expression for the probable quantity (Q) which will fall in a given time for a given gauge whose modulus is known is readily obtained.

Because E= the quantity for $\frac{1}{12}$ of a revolution, we have for $d\theta$ the quantity

$$dQ=12\frac{E}{2\pi}d\theta. \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Substituting in (2) the value for E in (1)

$$dQ=\frac{12}{2\pi}\theta_0\left\{M+M^{\frac{1}{2}}(\sin\theta+0{\cdot}4\sin 2(\theta-40^\circ)\right\}d\theta \ldots \quad (3)$$

Observing that $12A_0$ denotes the whole rainfall at the Observatory for the year to which the time under consideration belongs, denoting $12A_0$ by $\odot$, we have the following expression for the probable quantity fallen during the time elapsed between the sun's having the longitudes θ_1 and θ_2:—

$$Q=\odot M\times\frac{\theta_2-\theta_1}{2\pi}$$

$$\left\{1+\frac{1}{\sqrt{M}}\cdot\frac{[\cos\theta_1+{\cdot}2\cos_2(\theta_1-40^\circ)]-\cos\theta_2+{\cdot}2\cos 2(\theta_2-40)}{(\theta_2-\theta_1)}\right\}\cdot(4)$$

$\odot M$ denotes the gauge annual quantity obtained by multiplying Observatory quantities by modulus.

$\frac{\theta_2-\theta_1}{\pi}$ proportion of whole year elapsed.

$\odot M\frac{\theta_2-\theta_1}{2\pi}$ denotes the quantity on the supposition that for the whole year the fall is uniform.

The quantity ratio in any given time for the two gauges having the moduli M_1 and M_2 will be

$$\frac{Q_1}{Q_2}=\frac{M_1}{M_2}\frac{1+\frac{1}{\sqrt{M_1}}f(\Delta\theta)}{1+\frac{1}{\sqrt{M_2}}f(\Delta\theta)}, \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

where

$$f(\Delta\theta)=\frac{\Delta\cos\theta+0{\cdot}2\Delta\cos 2(\theta-40^\circ)}{\Delta\theta},$$

that is, this quantity-ratio varies throughout the year.

Wet season, dry season.—From the definition given in the body of the paper it follows that changes of season take place when

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$E=A_0M$, *i. e.* when the intensity attains the mean of the whole year, whence seasonal changes take place whenever

$$\sin\theta+0{\cdot}4\sin 2(\theta-40^\circ)=0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

This equation is satisfied by two values only of θ in the cycle; these are

$\theta=16^\circ\ 48'$, corresponds to beginning of December,

and

$\theta=159^\circ\ 41'$, corresponds to the 24th of April.

Points of maximum and minimum would of course have

$\frac{dE}{d\theta}=0$; this occurs four times in the cycle

namely, for

$\theta=\ 87^\circ\ 14'$ makes E a maximum, and corresponds to the 12th of February.

$\theta=217^\circ\ 37'$ makes E a minimum, and corresponds to the 22nd of June.

$\theta=258^\circ\ \ 4'$ makes E a maximum, and corresponds to the 28th of July.

$\theta=319^\circ\ 30'$ makes E a minimum, and corresponds to the 4th of November.

The quantity which falls during the wet season is given by taking θ between the two values which satisfy equation (6) in the equation derived from (3)

$$Q=\int\frac{12}{2\pi}A_0\{M+M^{\frac{1}{2}}(\sin\theta+\delta)\}d\theta. \quad \ldots\ldots\ldots\ldots\ldots \quad (7)$$

Wet season percentage.—If we divide the value of Q, as above obtained, by the annual quantity $=12_0A_0M$, we get the proportion of rain which falls during the wet season, and the *percentage* (n) *during the wet season* will be

$$n=40+\frac{34}{\sqrt{M}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

It will be remarked that this percentage decreases as M increases, that is, the greater M the more steady the rainfall throughout the year; it is less tropical in its character.

Cases $M=1$, $n=74$,

$M=4$, $n=40+17=57$.

Note.—The above value of n is only approximate, and consequently should not be tested by such values as $M=0$, $M=\infty$, and such like.

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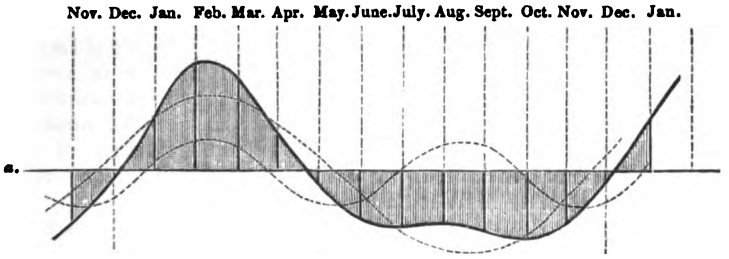
Appendix C.

Hypothetical Curve, showing generally, the nature of the Mauritius Rainfall.

[$\eta = \sin\theta + 0{\cdot}4\sin 2(\theta - 40^\circ)$, for notation see Appendix B.]



a. Mean monthly downfall.

..... Wet season..... +..... Dry season.....

Four and three-quarter months. Seven and a quarter months.

Appendix D.

Table giving the intensity of Rainfall for all the Gauges, as compared with Port Louis Observatory, arranged in order of intensity.

	Name of Gauge.	District.	District Letter.	Altitude.	Intensity = M.
a.	*Observatory	.....	.....	Sea	1·00
b.	*Gros Cailloux	.....	.....	Sea	0·93
t.	Flat Island (2)	.....	.....	Sea	1·05
	Pailles, Rev. Odell	.....	.....	200	1·21
g.	*Les Rochers	.....	.....	.....	1·66
f.	*Mont Choisy	.....	.....	.....	1·70
k.	Botanic Gardens	.....	.....	.....	1·99
u.	Elizabeth Cottage	.....	.....	.....	2·00
v.	Gentilly	.....	.....	.....	2·04
m.	Trianon	.....	.....	.....	2·07
i.	*Labourdonnais	.....	.....	.....	2·10
l.	Croft and Righ	.....	.....	.....	2·17
d.	*The Braes-vacoas	.....	.....	.....	2·23
h.	*Lucia	.....	.....	.....	2·25
q.	*Beau Vallon	.....	.....	.....	2·32
c.	*Beau Séjour	.....	.....	968	2·34
o.	*La Gaieté	.....	.....	.....	2·37
r.	St. Aubin	.....	.....	.....	2·84
n.	Gros Bois	.....	.....	.....	3·21
s.	Mesnil	.....	.....	1400	3·26
k.	Espérance	.....	.....	.....	3·58
e.	*Cluny	.....	.....	1000	4·72

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CORRESPONDENCE, &c.

To the Editor of the Meteorological Society's Proceedings.

Royal Observatory, Greenwich, London, S.E.

1869, March 23, 8h 39m G. M. T.—Saw a magnificent bolide resembling a brilliantly-coloured rocket (I think yellow was the predominant colour) for about 2 seconds only, during which it passed slowly like a ball of flame from about halfway between β Leonis and 12 Canum Venaticorum to within a short distance of Arcturus, when it suddenly vanished. There was much cirro-cumulus cloud about, which may have affected its appearance and duration of visibility. Looking towards the cloud, the brilliancy of the meteor suddenly attracted my attention at the boundary of a cloud. I was close to Woodlands, Blackheath.

W. T. Lynn, B.A., F.R.A.S.

Dalhousie, Punjab, February 11, 1869.

My dear Sir,—I have lately noticed a phenomenon here which I have never seen described, and am induced to send you a note in case it may be interesting to others.

Dalhousie is on the lower Himalaya range, about 6200 feet above the sea, and at this season is generally pretty well snowed up; but the present winter has been very warm, and there has been more rain than snow, and what has fallen has melted very soon.

I noticed some days ago, in walking along a road on the north side of the hill, an opalescent appearance, and on examination found it was caused by small columns of ice seemingly growing out of the hill-side. In this place the section of the hill was nearly perpendicular, and the soil black humus, which, in ordinary weather, weeps continually from the moisture it holds. The upper surface of dust seemed to have been raised bodily by the ice columns, whose upper surfaces formed a thin sheet of ice below this; they were small pillars from 1 to 2 inches high, quite separated and of small section, as if the ice had been forced in a plastic state through a sieve; many of the columns were bent but nowhere broken, and they did not penetrate the soil at all. I removed a good deal of this ice, and the phenomenon has been renewed. I had some difficulty in identifying the place a second time, as the dusty surface was continuous. When I first saw it, some accident had displaced part and exposed a section whose colour caught my eye. It is quite evident that the bases of these columns have been fed by the water weeping from the pores in the soil so gradually that they were raised perpendicularly to the surface instead of hanging down as ordinary icicles, and thus forming a sheet of ice. The curious thing is, to me, that in a mass so soft and loose as the humus, the surface only should have been wet and frozen in a sheet, while the water must have exuded from definite groups of pores to form the columns, such pores being quite invisible.

I am, yours faithfully,

J. Kennard.

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were balloted for and duly elected Fellows of the Society.

XLI. *On the Ozonometer for the observation of Ozone with an Aspirator, Instructions for its Use, and the Results obtained.* By John Smyth, jun., Esq., M.A., F.M.S., M.I.C.E.I.

Some time ago I was strongly attracted to the study of ozone, on being made acquainted with the important researches and discoveries of Dr. Andrews on the subject. Its bleaching-properties particularly interested me, as in the north of Ireland, where linen-bleaching is largely carried on, the most important part of the process is the exposure of the linens to the action of the air; hence the determination of the amount of ozone in the atmo-

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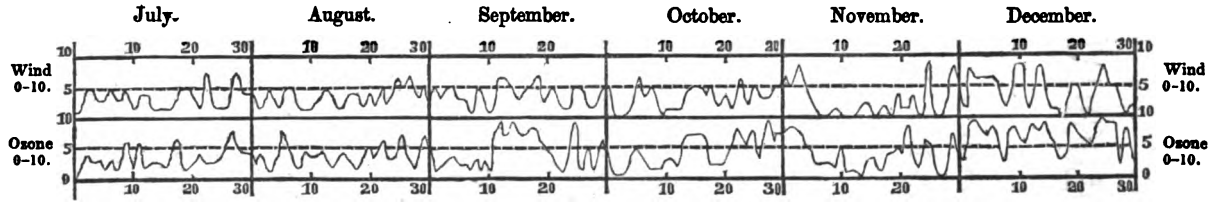
Fig. I. *Diagram showing the comparative intensities of the Wind and Ozone, from daily observations taken at* 9 A.M. *by John Smyth, jun., M.A., F.M.S., M.I.C.E.I.*

Milltown, Banbridge, Ireland, lat. 54° 23′ N., long. 6° 18′ W., 200 feet above the sea.

1868.



Wind.

The ordinates for the force-of-wind curve show the daily estimated strength to a scale from 0–10, calculated from daily observations made with the following scale from 0–6, viz. 0 calm, 1 gentle, 2 light, 3 moderate, 4 strong, 5 gale, 6 storm.

The ordinate for the wind is one half day in advance of that of the ozone, as explained under that head.

Ozone.

The ordinates for the ozone-curve show the intensity of the ozone for the previous twenty-four hours, as the test-papers are daily taken out of Clarke's cage, wetted, and compared with a scale of tints from 0–10; hence the mean of the ozone-observation is twelve hours behind the time of the estimated force of wind.

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sphere, and its effects, opened up for me an important inquiry. I have therefore continued during the last six years to take daily observations of the amount of ozone in the air by means of Clarke's cage, in which I suspended test-papers in the usual manner, and compared them with a scale of tints. I soon became dissatisfied with this method of observation, as the intensity of the tint was seriously affected by the force of the wind; on a calm day there was scarcely any discoloration, whilst on a stormy day there was an intense one. I then laid down on the diagram, Fig. 1., the curves of the intensity of the wind and ozone for several years, and found them to correspond very nearly with one another, as can be easily seen from inspection. This correspondence would have been still closer had all instead of a few of the observations of the force of wind been made from the indications of the anemometer. In common, however, with most of the observers of the Meteorological Society, I do this daily at 9 A.M. by estimating from the clouds, smoke, and trees, whether there is a calm, a gentle, light, moderate, or strong wind, a gale, or a storm, for which I put down the numbers 0, 1, 2, 3, 4, 5, 6 as the case may be.

In the examination of this diagram it must be remembered that, as the wind-curve only gives the force at one particular hour in the day, intermediate between the ozone mean intensity for that and the previous day, it is manifest that the two curves will correspond or not so far as the observed force has continued for some time or only commenced. In many cases it is quite calm at 9 A.M., although blowing a gale on the previous, or later on in the same day; this is especially observable in those months when light frosts or fogs prevail only in the morning. At first sight it would appear that the present mode of observation ought to give an approximation to the amount of sensible ozone passing over a given place in twelve or twenty-four hours; there are several considerations, however, unfavourable to this view. One of them is that the effect produced on the test-paper at the commencement of the exposure may be modified or destroyed by the subsequent effects of heat, moisture, or noxious exhalations; another, that there is generally found a quantity of liberated iodine inside the double wire-gauze cage. The consideration of these disadvantages, as well as some nice points which occurred to my mind, led me some years ago to try a known quantity of air by means of the aspirator. Some of the points which suggested themselves were:—Is

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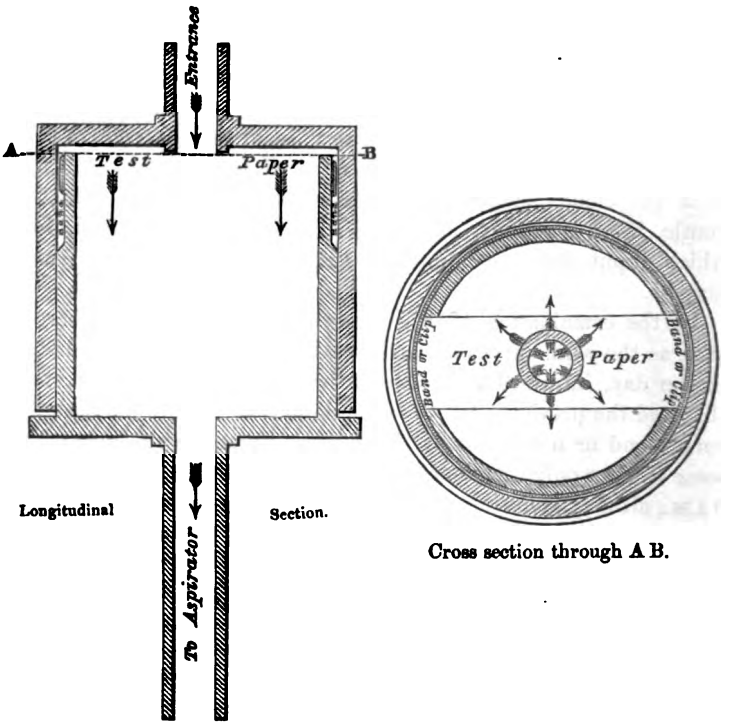
the ozone in the atmosphere a constant quantity? Has the force of the wind any effect in generating ozone by the motion of the particles of the air amongst themselves? To what extent is atmospheric ozone affected by heat, moisture, smoke, and the several foreign gases present in the air? There are many others; but I have mentioned sufficient to show the importance of the inquiry and the wide field it opens for research.

Fig. 2. *New Ozonometer.*

Natural Scale.



Cross section through A B.

I first tried several experiments with an ordinary-sized aspirator, and placed a piece of test-paper in the entrance-tube. I, however, got little or no indication of ozone in this way, and saw at once that, to ensure decided results, it would be necessary to use a very large aspirator, and have an extended surface of test-paper impinged upon by a rapid current of air from a small entrance-

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tube. So I had the ozonometer constructed, as seen in diagram Fig. 2 and described by me at the Meeting of the British Association in Birmingham in 1865. Two inside-coated brass, hard-wood, or opaque-glass tubes or boxes are made, about 2 inches long and 2 inches in external diameter; the inner one is so much less than the outer as to screw or fit tightly into it; it is also about $\frac{1}{8}$ of an inch shorter, and its extremity at the point of the screw is grooved for an india-rubber band which holds the test-paper stretched across its mouth. The entrance-tube, $\frac{1}{4}$ inch in diameter, is screwed or fitted into the centre of the solid extremity of the larger or outer box about $\frac{1}{8}$ of an inch from the centre of the test-paper. A small pipe or tube from the solid extremity of the smaller box communicates with the aspirator. The first large aspirator I used was an ordinary oaken cask of a capacity of 83 gallons, which was filled and refilled by a pump from a pond close to where the experiments were carried on; there was a loss both of time and labour in this operation, and a number of troublesome calculations involved in estimating the velocity of the air through the tube at the different levels of the water. I was therefore very glad to hear at this time of Dr. Andrews's aspirator, described by him in the 'Philosophical Magazine' for November 1852, and used in his recent experiments to establish the identity of the body in the atmosphere which decomposes iodide of potassium with ozone. It is constructed on the same principle as an ordinary gas-holder; the weights, however, do more than merely counterbalance the receiver, as they are used to raise it out of the water, and thus draw in the air.

I had one made of a capacity of 110 gallons or 5 hectolitres, provided with entrance- and discharge-tubes, which are conducted to the bottom of the tank and pass up through the water into the air-space under the bilge of the receiver. The entrance-tube is 1 inch in diameter, and its outer extremity is provided with a stop-cock which receives a flexible tube communicating with the ozonometer. The discharge-tube is 2 inches in diameter; and its outer extremity is provided with a stop-valve, the opening of which and the removal of the weights soon allow the cylinder or gasholder to empty and descend: this operation, however, is much accelerated by allowing a large annular weight to descend from the ceiling or frame supporting the pulleys, and rest upon the top of the cylinder until the descent is completed. The discharge-valve is then closed, the circular weight pulled up, and the weights

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which raise the cylinder slung on, their size being regulated by the time it is desired the experiment should occupy. A fresh strip of test-paper or cloth is then put into the ozonometer, which is connected to the flexible tube communicating with the aspirator and its entrance-tube thrust outside the window. As soon as the stop-cock is opened, the air commences to flow in with a regular velocity proportional to the extent of the opening.

In my experiments the time of filling the aspirator has varied from fifteen minutes to twenty-four hours, thus including a long range of velocities. When the aspirator is full, the stop-cock is closed, the ozonometer disconnected, the test-paper or cloth compared with a scale of tints, and the corresponding number entered in the usual manner. The ordinary test-papers, prepared by immersion in a solution of iodide of potassium and starch, are not sensitive enough for short observations, and, for reasons stated above, long exposures are objectionable; I therefore adopted the iodide-of-potassium or brown test-paper; I have made a great many experiments to determine what is the most convenient strength of solution to use, and find it is one part of iodide of potassium to ten of water. Pure filter-paper immersed in this solution shows a very sensible effect from one half minute's exposure; and by exposing different slips ½, 1, 2½, 5, 10, 15, 20, and 25 minutes I secured a regular series of shades, which I have imitated by colours on a slip of paper, and thus constructed a scale for reference from 0–10. I passed about 300 gallons of air over the paper, by filling the aspirator several times, to obtain the highest shade.

Test-paper prepared from a weaker solution is more easily preserved; its sensitiveness, however, is proportionably diminished; for instance, I found with one of iodide of potassium to twenty (instead of ten) of water, it showed just one-half the intensity of tint when exposed to the same volume of air. Strong test-paper may be preserved for a long time when pure materials are used in its preparation and it is kept free from the air in well-stoppered green-glass bottles in a dry warm place. I made some about six months ago, and, although the bottle containing it has been opened very often, the paper is still good.

By the advice of Dr. Andrews I have tried pure linen instead of paper, and found it to work very well.

In these experiments I passed about three gallons per minute through the ozonometer; so that, for a five minutes' exposure, a twenty-two-gallon or one-hectolitre aspirator would be sufficient,

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TABLE I. Milltown, Banbridge, Ireland (lat. 54° 23′ N., long. 6° 18′ W., 200 feet above the sea). Ozone-observations taken in August 1865, by the new Ozonometer, in connexion with an ordinary Aspirator of a capacity of eighty-three gallons (3·8 hectolitres).

Time of observation.	Barometer corrected.	Temperature.	Humidity, saturation = 100.	Cloud 0–10.	Wind.			Aspirator.	Ozone.				Remarks.
					Force 0–6.	Direction.	Velocity in miles per hour.	Velocity of Air through pipe in miles per hour.	Number of minutes exposed.	Tint on Test-paper in Ozone-cage.	Tint on Test-paper in Aspirator-ozonometer.	Effect produced in Aspirator-ozonometer.	
					EXPERIMENT No. 1.								
d h m	ins.	°										Sensible.	
15 12 17 P.M.	29·201	61	77	8	2	N.W.	...	...	5	...	...	—	
15 12 42 „	.....	...	...	...	...	...	...	14·6	15	...	...	Decided.	
15 1 12 „	29·205	...	...	...	...	...	...	10·3	30			Very dec.	
15 1 34 „	.....	61	77	8	2	N.W.	1·51	8·9	50	1	4		
					EXPERIMENT No. 2.								
16 9 40 A.M.	29·263	58	76	5	4	N.W.	...	...	5	...	...	Slight...	Run-off pipe partly choked by a little fish in this experiment.
16 9 48 „	.....	...	72	5	4	N.W.	...	12·3	10				
16 10 7 „	.....	...	...	5	4	W.	...	10·4	20	...	1½	Decided.	
16 10 28 „	.....	...	...	...	...	N.W.	...	7·8	35	...	2½		
16 11 28 „	29·295	61	70	5	4	N.W.							
16 11 23 „	29·313	56	81	5	4	W.	7·4	5·3	84	2½	4		
					EXPERIMENT No. 3.								
17 9 59 „	29·665	63	70	2	2	N.W.	...	13·3	5	...	...	Slight...	Pipe choked from same cause again.
17 10 11 „	29·667	63	65	2	3	N.W.	...	6·3	35	...	2½		
17 11 49 „	29·675	63	64	2	3	N.W.	2·9	4·8	93	1½	4		

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TABLE I. (*continued.*)

Time of observation.	Barometer corrected.	Temperature.	Humidity, saturation =100.	Cloud 0–10.	Wind.			Aspirator.	Ozone.				Remarks.
					Force 0–6.	Direction.	Velocity in miles per hour.	Velocity of Air through pipe in miles per hour.	Number of minutes exposed.	Tint on Test-paper in Ozone-cage.	Tint on Test-paper in Aspirator-ozonometer.	Effect produced in Aspirator-ozonometer.	
d h m	ins.	°											
					EXPERIMENT No. 4.								
21 10 59 A.M.	29·489	64	74	5	2	W.	...	15·5	5	...	2		
21 11 36 „	29·491	66	69	2	1	S.	...	10·1	25	...	4		
21 11 59 „	29·489	67	64	3	1	S.	2·7	9·2	48	1	5		
					EXPERIMENT No. 5.								
21 9 40 P.M.	29·484	58	89	5	1	S.E.	...	...	...	...	...	...	At night.
21 10 30 „	29·477	58	92	5	1	S.E.	0·6	8·9	50	½	3½		
					EXPERIMENT No. 6.								
23 10 45 A.M.	29·344	59	84	7	3	E.							
23 11 36 „	29·304	61	80	7	3	E.	3·94	8·4	53	1	4		
					EXPERIMENT No. 7.								
23 5 23 P.M.	29·350	63	72	4	2	N.E.	...	...	5	...	5		Iodide-of-potassium test-paper used.
23 6 15 „	29·358	61	77	3	2	N.E.	3·95	8·4	53	1½	7		
					EXPERIMENT No. 8.							...	
25 10 55 A.M.	29·937	64	69	2	3	E.S.E.	...	...	5	...	5		
25 11 50 „	29·933	67	62	1	3	S.E.	7·2	7·4	60	2	7½		

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and with a wooden ozonometer the whole apparatus could be made at a small cost.

It is very desirable that all meteorological observers should make daily a five minutes' observation with this ozonometer by means of some form of aspirator on one hectolitre of air, as very important results would be obtained, and a host of pressing questions answered.

I beg now to refer to the Tables of experiments, given to show the results obtained.

Table I. gives full particulars of some experiments made in 1865.

In experiment No. 1 a very sensible coloration was produced on the test-paper in the ozonometer after 5 minutes' exposure, and gradually increased at 15 and 30 minutes, until at 50 minutes the tint corresponded to 4 on the scale; in the cage in the same time the tint did not rise higher than 1.

In No. 2 the tint in the ozonometer also increases gradually in proportion to the quantity of air admitted, and the final effect is the same as in No. 1; in the cage it is $2\frac{1}{2}$, which is greater than in No. 1, since the force of the wind is greater.

In No. 3 the tint in the ozonometer is also 4, and in the cage $1\frac{1}{2}$.

In No. 4 the tint in the ozonometer is 5, and in the cage 1; the highest temperatures are registered in this case.

In No. 5, which was conducted at night, the tint is only $3\frac{1}{2}$ in the ozonometer (as there was much moisture in the air), and $\frac{1}{2}$ in the cage.

In No. 6 the tint in the ozonometer is 4, and in the cage 1.

In Nos. 7 and 8, instead of Lowe's, iodide-of-potassium paper was used. In No. 7; in the ozonometer the tint was 7, and in the cage $1\frac{1}{2}$; in No. 8 the air was very dry, and the tint $7\frac{1}{2}$ in the ozonometer, and 2 in the cage.

An inspection of this Table shows, as I then stated before the British Association, that there is not much, if any, difference in the quantity of sensible ozone in two masses of air of equal volume moving at different velocities, and under different hygrometrical conditions. The experiments also show that the shelter given by the thermometer-stand and cage somewhat modify the effects of the velocity of the wind on the test-paper in the latter; during the prevalence of northerly winds, as the stand is more open in that direction, this modification is the least.

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TABLE II. Milltown, Banbridge, Ireland (lat. 54° 23′ N., long. 6° 18′ W., 200 feet above the sea-level). Ozone-observations taken by the new Ozonometer, connected with an ordinary Aspirator of a capacity of eighty-three gallons (3·8 hectolitres).

Date.	Ozone.			Wind.		Velocity in miles per hour.		Mean Temperature.	Relative Humidity, saturation = 100.	Remarks.
	Test in new Ozonometer.	Test in Clarke's Ozone-cage.	Time exposed.	Force.	Direction.	Air in Aspirator.	Wind.			
1865.			minutes.					°		
Aug. 15	4	1	50	2	N.W.	9	1½	61	77	
,, 16	4	2½	84	4	W.N.W	5½	7½	58	75	
,, 17	4	1½	93	2½	N.W.	4⅝	3	63	66	
,, 21	5	1	48	1½	S.S.W.	9½	2⅝	66	69	
,, P.M.	3½	½	50	1	S.E.	9	½	64	90	Very damp.
,, 23	4	1	53	3	E.	8½	4	60	82	

TABLE III. Experiments with the same Ozonometer connected with Dr. Andrews's form of Aspirator of a capacity of 110 gallons (5 hectolitres).

1866.			hours.							
Jan. 4	7	7	23	4	S.	·16	...	40	87	
,, 11	7	9	23	0	N.W.	·16	...	31	95	
,, 12	7	8	23	4	S.W.	·16	7	38	94	
,, 19	7	7	22	4	W.	·16	11	46	88	
,, 25	7	7	16	3	S.W.	·24	3·8	46	88	
,, 27	7	8	16	4	S.	·24	4·6	43	88	
Feb. 8	7	7	2·3	4	S.	·16	...	41	92	
,, 22	6	8	1·5	4	W.	...	...	38	77	
,, 23	7	8	3	4	S.W.	...	...	39	86	
1867.										
Mar. 12	7	4	23	4	N.E.	·16	...	35	83	

TABLE IV. Ozonometer brought from top of tower and placed close to window, 12 feet lower, the entrance-tube passing through window-pane.

1866.										
Aug. 12	1	5	3½	1	S.W.	...	...	58	78	Entrance-tube 2 ft. long, heated by lamps.
,, 12	3	5	3½	1	S.W.	...	...	58	78	Not heated.
,, 12	5	5	3½	1	S.W.	...	...	58	78	2-ft. entrance-tube replaced by glass cock and short tube.

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TABLE V. Experiments made with pure filter-paper dipped in a solution of 1 of iodide of potassium to 10 parts of water, and exposed for 5 minutes in the Ozonometer, through which three gallons of Air per minute were drawn by Dr. Andrews's form of Aspirator.

Date.	Ozone 0–10.		Wind.		Temp. of Air.	Relative Humidity. saturation 100.	Remarks.
	Test in New Ozonometer.	Test in Clarke's Ozone-cage.	Force 0–6.	Direction.			
1868.					°		
Oct. 26 9 0 A.M.	5	7	2	S.W.	43	78	
„ 27 9 0 „	5	4	3	N.W.	42	81	
„ 28 9 0 „	4	9	2	S.	42	92	Fog; paper taken out damp.
„ 28 10 0 „	3	...	...	...	...	96	Increased fog. [dried.
„ 28 10 10 „	4	...	...	...	...	96	Ozonometer warmed, tube
„ 28 10 20 „	4·5	...	...	...	...	96	„ and test-paper warmed.
„ 29 8 0 „	5						
„ 29 9 0 „	5	6	2	S.W.	41	82	
„ 30 9 0 „	5	7	3	W.	46	90	
„ 31 9 0 „	5	7	3	S.	53	93	
Nov. 1 9 0 „	5	8	4	S.W.	58	88	
„ 2 9 0 „	5	8	3	S.W.	45	78	
„ 3 9 0 „	5	7	5	S.W.	50	81	
„ 4 9 0 „	5	6	4	S.W.	44	82	
„ 5 9 0 „	4	4	2	W.	35	96	Foggy.
„ 5 9 15 „	5	...	...	...	...	...	Warmed ozonometer.
„ 6 9 0 „	5	3	1	N.W.	34	89	
„ 7 9 0 „	5	3	0	N.	31	85	
„ 13 9 0 „	0	0	0	S.E.	27	100	
„ 14 9 0 „	0	2	1	S.E.	40	100	Fog.
„ 16 9 0 „	1	1	0	N.E.	36	94	
„ 18 9 0 „	1	4	0	N.E.	42	95	
„ 19 noon.	5	5	2	S.E.	41	83	
Dec. 5 „	5	7	4	S.	48	86	
1869.							
Apr. 15 9 0 A.M.	5	4	2	S.	51	80	

Table II. is an abbreviation of Table I., showing more distinctly the constancy of the tint or shade in the ozonometer, and the irregularity of the same in the cage, following in the latter case the varying velocities of the wind.

Table III. shows the results of a number of experiments conducted by means of a 110-gallon aspirator of Dr. Andrews's construction, in which the exposures of the test-papers were for the most part continued nearly twenty-four hours, and exhibit a remarkable sameness; the tint registered is 7 in every case but one, in

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which the time of exposure was only one hour and a half, and the number registered 6.

Table IV. shows the effect heat has in destroying ozone, as in the first experiment (when the entrance-tube was heated) the shade is 1, and in the second (when no heat was applied) 3. The third experiment shows how a greater effect is obtained from a short entrance-tube, as 5 is registered, and not 3 as in the second case, where the entrance-tube was 2 feet long: I attributed this result to the greater deposition of moisture in the additional length of tube.

Besides these experiments, I tried, by drawing the air into the ozonometer through smoke, whether the sensible ozone would be diminished, and found it was so to a large extent, although the quantity of smoke was small.

Table V. For these experiments the same aspirator was used as in the last two Tables; the exposures, however, were very short, merely five minutes, as the sensitive standard iodide-of-potassium test-paper, described above, was exposed in the ozonometer. The same tint is registered in all these experiments, except a few where fog prevailed and the moisture destroyed either the ozone or the effect produced on the paper. The ozonometer is on lower ground and nearer the river than the thermometer-stand, so that the moisture was greater, for the most part, at the ozonometer than that shown in the Table taken from the readings of the dry and wet bulbs. In the 28th-of-October observation the effect of the moisture is very apparent; at 9 A.M. the weather was foggy, and the paper damp when taken out of the ozonometer, and the tint registered 4. At 10 A.M. the fog was greater, and 3 was registered; the ozonometer was then warmed in the steam-oven and the entrance-tube dried with cotton-wool, and the tint registered was 4. At $10^h\ 20^m$ A.M. both test-paper and ozonometer were warmed and dried, and $4\frac{1}{2}$ was registered. To try still further the effects of moisture, on November the 2nd I damped some test-paper which had been tinted 5; it came down to about 3. I then damped untinted test-paper and exposed it for 5 minutes as usual in the ozonometer; when taken out it was spotted with different shades, corresponding to 3, 4, and even 5; the tint was deepest in those spots which were soonest dried by the current of air.

Due allowance being made for slight differences in the arrangement of the apparatus, these additional experiments and observa-

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tions made since 1865 confirm in a marked manner the results then obtained as to the constancy of ozone in the atmosphere, and prove, that if any variation does occur, it is so small as not to be estimated by the present usual manner of observation. This question might be set at rest by the use of much more delicate tests than made hitherto, in a series of carefully conducted experiments in different localities by means of my ozonometer. Such experiments would be very useful to determine, in localities where the air is not so pure as at Banbridge, to what extent the ozone is destroyed or rendered insensible by the agents referred to above and other influences.

In conclusion, from my long study of the subject, and the result of my many experiments, I am of opinion that, under *normal* atmospheric conditions, the amount of ozone in the air is absolutely constant.

XLII. *On the heavy Snowstorms of the Winter* 1868–69, *in the Province of Quebec, Dominion of Canada.* By CHARLES SMALLWOOD, M.D., LL.D., D.C.L., Professor of Meteorology in the University of M^{c}Gill College, and Director of the Montreal Observatory.

THE unprecedented large amount of snowfall (being by far the greatest amount from available records) has made me presume that a short paper on the subject would not be out of place and would be a matter of interest to the Members of the Meteorological Society.

I might, before proceeding further, state that the geographical coordinates of the place of observation are long. 4^{h} 54^{m} 17^{s} W. of Greenwich, and lat. 45° 31′ N., the height of the cistern of the barometer is 182 feet above the mean sea-level, and the obsertions are all corrected and reduced to 32° Fahr.

The daily means are deduced from observations taken at 7 A.M., 2 P.M., and 9 P.M. daily; the amount of snow, owing to heavy drifts, has been measured and recorded at short intervals of time in a snow-gauge, the construction of which is simple and seems from experience well adapted to the purpose, and which has so served for many years.

The anemometer is a modification of Dr. Robinson's of Armagh,

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and, from constant observations taken for more than twenty years, would seem the only form adapted for recording the velocity and direction of the wind in our Canadian climate, and, so far as my own observations go, far surpasses the inventions of Osler, Whewell, Phillips, and Lind, having given each a fair trial.

The first snow of the autumn 1868 fell on the 17th of October, inappreciable in quantity. Winter fairly set in on the 7th of December, and the crossings on the St. Lawrence in front of the city (Montreal) were good on Christmas-day; the smaller rivers were sufficiently frozen over some fifteen or twenty days before. The following Table shows the date at which winter fairly set in and all out-door work was suspended, for the eight years from 1860 to 1867.

Years.	Date.	Years.	Date.
1860	December 2nd.	1864	December 12th.
1861	,, 28th.	1865	,, 22nd.
1862	,, 19th.	1866	,, 16th.
1863	,, 9th.	1867	,, 1st.

The following Table shows the number of days on which snow fell, and the amount, for the winter 1868 up to the 26th of March.

Months.	Days.	Amount in inches.
1868, October	3	4·92
,, November	6	17·28
,, December	14	27·96
1869, January	15	28·07
,, February.....	17	73·76
,, March up to the 26th day, date of this report.....	7	11·67
Totals	62	163·66

The first great snowfall of February set in at 7 A.M. of Wednesday the 3rd day, barometer 29·751 in., thermometer 8°·2, wind N.E. by E., mean velocity 4·91 miles per hour; the amount of snow which fell up to 9 P.M. was 13·90 inches; this continued with a falling barometer, which, at 9 P.M., stood at 29·299 inches, thermometer 17°, the wind increasing. The following Table shows the hourly velocity in miles during the night.

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Date.	Hours.	Miles per hour.
February 3	9 to 10 P.M. ...	7·10
	10 „ 11 „ ...	9·00
	11 „ 12 „ ...	10·70
	12 „ 1 A.M. ...	12·45
February 4	1 „ 2 „ ...	18·30
	2 „ 3 „ ...	20·40
	3 „ 4 „ ...	25·70
	4 „ 5 „ ...	28·10
	5 „ 6 „ ...	27·50
	6 „ 7 „ ...	25·04

Only 8·72 inches of snow fell during the hours of 9 P.M. till 7 A.M. of the 4th day; but the high wind carried the loose snow with great violence into enormous drifts some 15 to 20 feet high (the amount was about 22·62 inches at this time), rendering travelling by rail entirely suspended, and by sleighs very difficult; snow-shoes were generally resorted to as the only means of reaching the city by men of business who resided at any distance.

The barometer at 7 A.M. of Thursday the 4th indicated 28·841 inches, thermometer 16°·4. From this time a gradual rise was perceptible; the snow ceased at 4 P.M.; and at 9 P.M. the barometer stood at 28·999 inches, thermometer 17°·1, the total amount of snow 25·44 inches.

At Halifax, Nova Scotia, at midnight on the 2nd of February, the barometer began to fall, and a snowstorm from the east set in at 10.30 P.M., which continued until 10 A.M. of the 4th day, barometer indicating 28·761 inches.

The second storm of February commenced at $8^h\ 15^m$ P.M. of the 14th day, and ceased at $2^h\ 15^m$ P.M. of the 16th day; the total amount of snow which fell was 14·90 inches.

The next snowstorm commenced at 3 A.M. of the 23rd day, and ceased at $6^h\ 50^m$ P.M. of the same day, amounting to 11·15 inches. There were, besides, several slight snowfalls during the month; so that the whole amounted to the large quantity of 73·76 inches.

On the 18th of March, at 4 A.M., another heavy storm set in, with a stiff breeze from the N.E. by E.; at 7 A.M. the barometer stood at 29·770 inches, and fell to 29·119 inches at 10 P.M.; the thermometer at 7 A.M. stood at 16°·1, but fell at 2 P.M. to 8°, and rose to 12°·2 at 9 P.M. Snow ceased to fall at 11 P.M., showing a total of 8·82 inches, which was followed by a high wind from the west, mean velocity 18·69 miles per hour, which caused very heavy drifts and in a most effectual way stopped all modes of

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travel. Rail-road trains were snowed up for several days; passengers suffered from hunger as well as delay. This storm was severely felt, owing to the decrease of temperature to 8°, and to the presence of previous heavy falls and drifts.

These drifts had been cut through on the railway-tracks, forming, as it were, immense tunnels, or snow-banks on either side some 20 feet high, that were readily filled up again by the drifting snow carried by the high wind, which packed it close and hard, so that no amount of power used by three or four heavy steam locomotives could force through it, which in their turn became *snowed up*, until dug out by swarms of men furnished with shovels.

Some slight snow-showers fell, but of no great amount.

The mean temperature of January was 5° above the isothermal for Montreal, deduced from observations during a long series of years, and was 10° higher than last January (1868).

The mean of February was 9°·84 higher than last February (1868), and 3°·34 higher than the isothermal for Montreal.

The mean of the snowfall for the last twenty years is 79·50 inches per annum; the greatest depth which fell in one month during the above time, fell in January 1866 and was 45·74 inches.

The greatest depth which fell in one day during the above period was 11·15 inches (except in February 1869, which is not taken into these means); 105·81 inches fell in 1868; but this great amount is owing to the unusually large quantity which fell in October, November, and December.

At Toronto, from the observations of my friend Professor Kingston, and which are perfectly reliable, the amount of snow which fell in 1867 was 110·5 inches, the average amount for the past twenty-four years being 62·9 inches; and the greatest amount which fell in one day was 15 inches.

In conclusion, I might just remark, for the purpose of illustrating the climatology of Montreal, that from the years 1824 to 1868, a period of forty-four years, the ice left the St. Lawrence, in front of the city, at periods varying from the earliest, 16th of March (1825), to the latest, April 28th (1855), showing a variation of forty-three days during this period of forty-four years; the earliest periods are not confined to recent dates, but occurred in 1825, 1828, 1834, and 1842, during the month of March, dating the 16th, 29th, 29th, and 31st respectively.

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TABLE showing the amount of Snowfall for the past Seven Years, as a source of comparison for the large amount of 1869 for Montreal.

Years.....	1862.	1863.	1864.	1865.	1866.	1867.	1868.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.
January	36·85	13·28	37·85	24·00	45·74	31·64	12·64
February ...	27·77	11·55	23·25	12·40	9·75	13·55	22·20
March.....	17·75	16·29	6·10	9·79	13·54	14·16	5·34
April	3·71	3·78	0·20	1·49	.....	7·90	14·93
May	.....	Inapp.	.....	.....	.....	.....	.....
June	.....	.....	.....	.....	.....	.....	.....
July	.....	.....	.....	.....	.....	.....	.....
August	.....	.....	.....	.....	.....	.....	.....
September ...	.....	.....	.....	.....	.....	.....	.....
October	.....	.....	.....	0·96	Inapp.	.....	4·92
November ...	Inapp.	4·61	6·90	14·41	Inapp.	10·54	17·82
December ...	10·42	19·36	27·02	7·11	30·81	25·26	27·96
Total	96·50	73·87	101·32	70·16	99·84	103·05	105·81

	ins.
1869, January	28·17
„ February	73·76
„ March up to 26th	11·67

The following Table, obtained from some old records, shows the amount of snowfall from 1830–38, inclusive, for Montreal.

Years.....	1830.	1831.	1832.	1833.	1834.	1835.	1836.	1837.	1838.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
January	.....	6·90	21·30	15·50	11·80	11·85	18·20	.....	.....
February ...	.....	23·30	25·85	14·45	3·40	21·80	19·35	.....	.....
March	.....	12·00	21·35	7·15	8·95	19·65	14·40	.....	.....
April	.....	.....	.....	.....	.....	.....	.....	.....	.....
May	.....	.....	.....	.....	.....	.....	.....	.....	.....
June	.....	.....	.....	.....	.....	.....	.....	.....	.....
July	.....	.....	.....	.....	.....	.....	.....	.....	.....
August	.....	.....	.....	.....	.....	.....	.....	.....	.....
September ...	.....	.....	.....	.....	.....	.....	.....	.....	.....
October	.....	.....	.....	0·60	1·60	0·10	3·55	2·65	3·20
November ...	3·10	4·65	7·80	3·35	2·95	11·95	5·00	.....	9·75
December ...	26·50	27·45	15·60	21·90	27·70	13·50	.....	.....	.....
Totals.....	?	74·30	91·90	62·95	56·40	78·85	?	?	?

The winter of 1745 is said to have been very mild, only 24 ins. of snow falling.

The winter of 1826–27 no snow fell until the 17th of January (1827), and there fell from the 17th to the 18th from 60 to 72 ins.; drifts from 15 to 20 feet high were not unfrequent at that time.

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XLIII. *On the Connexion between the Relative Positions and Directions of Air-currents and the Barometric Pressure in the Southern Indian Ocean.* By CHARLES MELDRUM, Esq., M.A., F.M.S.

OBSERVATIONS made on the polar side of the 30th parallel of south latitude, in the Indian Ocean, reveal, on almost any day, the existence of alternate bands of northerly and southerly winds. I have recently endeavoured (Proc. no. 41, vol. iv. p. 283) to point out the connexion between these air-currents and the rotation of the wind; and I now beg to indicate what appears to be the connexion between them and the barometric pressure.

When the northerly is to the eastward of the southerly current the pressure is *lowest* between their adjacent confines; but when the northerly is to the westward of the southerly current the pressure is *highest* between their adjacent confines. In other words, the lowest pressure is always on the western edge of the northerly and the eastern edge of the southerly current, and *vice versâ*. Hence, when there are several alternate currents more or less parallel, and extending over 15° or more of latitude, there are alternate corresponding bands of high and low barometer, the former constituting, as it were, *ridges* or *crests*, and the latter *valleys* or *troughs*, the decrease in pressure from the *crest* to the *trough* being more or less rapid, and amounting sometimes to 2 inches of the mercurial column.

The currents, however, at their inner borders, not unfrequently appear to flow into one another, so as to form more or less complete cyclones; and then the *crests* and *troughs* become elliptical or circular patches of high and low barometer, the air in the one case moving round from right to left, and in the other from left to right.

But whether the currents flow in parallel bands, or in curves, the connexion between their direction and the barometric pressure seems to be the same, the wind in both cases crossing the isobars at angles seldom exceeding 45°, and generally not more than 30°.

With regard to these extra-tropical air-currents, then, numerous observations show that if an observer turn his back to the wind, the barometric pressure will be *less* towards his right hand than towards his left, without any reference to the point from which the wind is coming, or to its character as a polar or equatorial current.

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Now, as we know that the whole system travels to the *eastward*, that the barometric *troughs* and *hollows* are usually accompanied by cloud and rain, and often by thunder and lightning, that the barometric *slopes*, especially when steep, are characterized by high winds, and that the *crests*, *ridges*, or *elevations* are the localities of light winds and fine weather, we possess to a considerable extent the means of knowing what atmospheric changes will succeed each other at a particular station, or on board a ship, in those latitudes. And if it could be shown that the systems and their attendant phenomena have periodicities, which they may have, we should know the times of change beforehand, as well as the order of succession.

Turning now to the south-east trade and the north-west monsoon within the tropics, we find the same connexion between them and the barometric pressure. In the summer of the southern hemisphere they are separated by a belt of calms and variables extending from about lat. 18° S. on the western, to about lat 5° S. on the eastern side of the ocean. North and south of that belt the pressure increases to the polar limits of the trade-winds. Now, as the isobars are crossed by the wind at angles varying from a few degrees to about 45°, it follows that when an observer turns his back to the wind, the pressure is *less* towards his right hand than towards his left.

When, again, at their adjacent borders, the trade and monsoon winds curve so as to form cyclones, and to break up the elongated barometric *trough* into elliptical or circular *hollows*, around which the air flows from left to right, the isobars also curve; and as the wind still crosses them at an angle which seldom exceeds 45°, and is generally considerably less, the rule that a person with his back to the wind has a *lower* barometer on his right hand than on his left, holds good in this case also.

The existence of the alternate bands of northerly and southerly winds, south of the 30th parallel, and of corresponding areas of high and low pressure, all having an easterly progression, was shown in a paper published in Mauritius in 1856. The position of the belt of calms, also, between the trade and the monsoon, was pointed out in the same publication. On the other hand, the connexion between the direction of the wind and the barometric pressure in the tropical cyclones was known to the earlier writers on the subject. However, the principles of rotation, progression, and relation of wind to pressure which are now beginning to be

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accepted, have been used as the bases of storm-warning in Mauritius during the last twelve years.

From the results of observations on the extra-tropical winds of the northern hemisphere within that period, it would appear that the same law obtains there as in the Southern Indian Ocean. The opposite currents of air, with their attendant phenomena of high and low barometer, sunshine and calm, cloud, rain, and storm, have generally an easterly progression. From the eastern to the western edge of the southerly winds the barometer falls, and from the eastern to the western edge of the northerly winds it rises, being highest at their adjacent confines when the northerly is to the eastward of the southerly current, and *vice versâ*. And the relation between the direction of the wind and the pressure seems to be such that when an observer turns his back to the wind the pressure is *lower* towards his left hand than towards his right.

Or, if the northerly winds in the northern and the southerly winds in the southern hemisphere be regarded as polar currents, and the southerly winds in the northern and the northerly winds in the southern hemisphere as equatorial currents, the lowest barometer in both hemispheres will be on the western edge of the equatorial and the eastern edge of the polar current, and the highest barometer on the western edge of the polar and the eastern edge of the equatorial current.

When the two currents form cyclones the same relation between them and the pressure obtains in both hemispheres.

It should be remarked, however, that there are apparently exceptions to the rule as to the relation between the pressure and the direction of the wind, the wind at times (and especially at a considerable distance from the centre of depression) crossing the isobars nearly at right angles.

XLIV. *Weather-Signs, as to Temperature.*

By F. W. Doggett, Esq., F.M.S.

For years I have been working at the monthly mean temperature and rainfall, in the belief that out of the seeming confusion of many figures I might arrive at some facts indicating the state

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of the weather in the future approximately, as I firmly believe that law governs in this as in all other natural circumstances; but until lately I had almost despaired of success, in consequence of the many failures I had experienced.

About twelve months ago, in getting out the weather for the years which had produced the largest crops of hops, I observed that the months of October and April immediately preceding each of them had been warm.

At first I did not value the fact beyond the object I had in view; but afterwards it appeared to me that there might be some connexion between these warm months and warm summers, they being the months following the autumnal and vernal equinoxes.

I then took out all the warm and cold summers since 1815, and the mean temperatures of the Octobers and Aprils preceding; the results I give in Table I.

It will be seen that, with very few exceptions, when the temperature of October and April is above the mean, warm summers have followed; also, that when those months have both been cold, warm summers have again occurred; but when the October has been warm and the April cold, cold summers have succeded, and that when October has been cold and April warm, cold summers have also followed.

The exceptions, however, mostly vanish when the temperature of the month of March is taken into consideration in addition to that of April.

In Table II. this will be very apparent.

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TABLE I. Shows that when

October and following April are warm } the succeeding summer is warm.
" " " " cold }

" warm " " " } the succeeding summer is cold.
" cold " " warm }

With a few exceptions in each case.

	Year.	Temp. of Oct.	Year.	Temp. of April.	Temp. of July, Aug., and Sept.		Year.	Temp. of Oct.	Year.	Temp. of April.	Temp. of July, Aug., and Sept.
		°		°	°			°		°	°
	1818	+4·4	1819	+2·5	+1·8		1815	+2·1	1816	−2·3	−2·3
	1821	+1·0	1822	+1·0	+0·5		1816	+1·5	1817	−1·8	−3·2
	1824	+0·5	1825	+3·0	+2·9		1822	+2·7	1823	−2·9	−1·3
	1825	+1·5	1826	+3·3	+2·4		1828	+0·6	1829	−2·0	−2·4
	1826	+3·1	1827	+1·1	+0·4		1832	+1·9	1833	−0·5	−2·0
	1827	+2·5	1828	+0·8	+0·1		1837	+1·3	1838	−4·1	−1·2
	1830	+1·6	1831	+2·4	+1·9		1838	+0·7	1839	−4·8	−1·2
	1831	+5·7	1832	+1·5	+0·2		1847	+3·6	1848	−1·9	−0·8
	1834	+1·2	1835	+0·7	+2·2		1859	+1·0	1860	−2·9	−3·3
	1845	+0·9	1846	+1·4	+3·2	Except.	1846	+1·2	1847	−0·4	+1·2
	1849	+1·8	1850	+2·8	+0·2		1848	+2·3	1849	−2·5	+1·9
	1851	+3·3	1852	+0·2	+1·2		1860	+1·2	1861	−1·5	+0·9
	1853	+1·6	1854	+2·7	+1·3						
	1854	+0·1	1855	+0·1	+1·0						
	1855	+1·9	1856	+0·7	+0·5						
	1856	+3·4	1857	0·0	+2·4						
	1857	+3·6	1858	+0·5	+1·6						
	1858	+1·5	1859	+0·8	+3·3						
	1864	+0·8	1865	+6·5	+3·0						
	1866	+1·6	1867	+3·1	+0·1						
Exceptions.	1865	+1·2	1866	+2·0	−0·6						
	1863	+2·1	1864	+2·4	−0·1						
	1862	+2·3	1863	+3·3	−0·7						
	1861	+5·4	1862	+2·6	−0·9						
	1844	+0·2	1845	+0·6	−0·7						
	1817	−4·3	1818	−0·1	+4·1		1819	−1·8	1820	+3·6	−1·9
	1823	−1·7	1824	−1·9	+0·7		1829	−1·8	1830	+2·6	−1·2
	1833	−1·0	1834	−0·7	+2·2		1839	−0·4	1840	+2·1	−1·3
	1841	−0·5	1842	−0·5	+1·3		1840	−2·5	1841	+1·5	−0·6
	1850	−2·3	1851	−1·1	+1·2		1843	−1·3	1844	+6·0	−0·7
Except.	1835	−1·3	1836	−2·4	−1·0	Except.	1820	−2·3	1821	+4·7	+0·3
	1836	−1·9	1837	−6·6	−0·6		1842	−3·9	1843	+1·4	+1·4
	1852	−1·4	1853	−0·5	−0·8						

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Table II.

Shows that warm summers are preceded by warm Marches or Aprils, but mostly by both warm;

And that cold summers are preceded by cold Marches or Aprils, sometimes both being cold,—

Thus explaining some of the exceptional years in Table I.

Year.	Temp. of March.	Temp. of April.	Temp. of July, Aug., and Sept.	Year.	Temp. of March.	Temp. of April.	Temp. of July, Aug., and Sept.
	°	°	°		°	°	°
1818	0·0	−0·1	+4·1	1816	−1·7	−2·3	−2·3
1819	+3·1	+2·5	+1·8	1817	+0·7	−1·8	−3·2
1821	+1·9	+4·7	+0·3	1823	−1·1	−2·9	−1·3
1822	+6·4	+1·0	+0·5	1829	−1·9	−2·0	−2·4
1825	−2·4	+3·0	+2·9	1833	−3·3	−0·5	−2·0
1826	+2·3	+3·3	+2·4	1837	−5·1	−6·0	−0·6
1827	+2·2	+1·1	+0·4	1838	+0·6	−4·1	−1·2
1828	+2·6	+0·8	+0·1	1839	−1·9	−4·8	−1·2
1831	+3·0	+2·4	+1·9	1840	−3·3	+2·1	−1·3
1832	−0·4	+1·5	+0·2	1845	−5·7	+0·6	−2·5
1834	+3·1	−0·7	+2·2	1848	+2·9	−1·9	−0·8
1835	+0·1	+0·7	+2·2	1860	+0·2	−2·9	−3·3
1842	+4·0	−0·5	+1·3				
1846	+2·4	+1·4	+3·2				
1847	+0·1	−0·4	+1·2				
1849	+1·6	−2·5	+1·9				
1850	−1·0	+2·8	+0·2				
1851	+1·7	−1·1	+0·4				
1852	+0·4	+0·2	+1·3				
1854	+2·9	+2·7	+0·4				
1855	−3·0	+0·1	+1·0				
1856	−2·2	+0·7	+0·5				
1857	+0·9	0·0	+2·4				
1858	+0·5	+0·5	+1·6				
1859	+5·5	+0·8	+3·3				
1861	+2·9	−1·5	+0·9				
1865	−4·4	+6·5	+3·0				
1867	−3·3	+3·1	+0·1				
1868	+3·1	.....	+4·3				

XLV. *Weather-Signs, as to Rain.*

By F. W. Doggett, Esq., F.M.S.

The two following Tables require but few words of introduction; in Table I. it will be seen that when the temperature of the month ♌ June has been *above the the mean* the next year has been *dry*,

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and when the same month has been *cold* the next year has been *wet*, with a few exceptions.

TABLE I.

When month of June warm, next year dry.
And when month of June cold, next year wet, with exceptions.

Year.	Temp. of June.	Departure from average Fall of Rain in the following Year.	Year.	Temp. of June.	Departure from average Fall of Rain in the following Year.
	°	ins.		°	ins.
1817	+1·1	−1·1	1816	−4·9	+2·0
1822	+4·6	+0·1	1820	−1·9	+6·9
1825	+0·9	−3·6	1821	−3·9	+0·7
1826	+4·9	−1·9	1823	−2·6	+7·5
1828	+2·0	−1·6	1827	−0·4	+4·1
1832	+1·2	−3·6	1830	−2·7	+3·4
1833	+1·8	−6·7	1838	−0·8	+2·4
1834	+3·1	−1·7	1843	−1·7	+0·4
1835	+2·0	+0·1	1847	0·0	+5·7
1836	+1·0	−5·4	1851	−1·0	+9·7
1837	+0·1	−2·9	1852	−1·9	+4·5
1839	+0·7	−7·9	1867	0·0	+0·7
1842	+4·9	+0·1			
1844	+2·7	−2·1	1824	−3·0	−2·1
1846	+7·3	−6·7	1841	−1·6	−1·7
1848	+0·5	−0·6	1849	−0·1	−4·8
1850	+2·8	−2·9	1854	−2·3	−3·4
1853	+0·2	−6·0	1855	−1·1	−2·3
1856	+0·5	−3·1			
1857	+3·8	−7·3			
1863	0·0	−9·6			
1818	+4·9	+2·8			
1829	+1·0	+0·4			
1840	+1·5	+8·8			
1845	+2·7	+0·8			
1859	+6·9	+7·5			
1861	+1·0	+1·9			
1865	+2·2	+6·1			
1866	+2·8	+3·9			

Table II. shows that when the months of January, February, and March have been *dry* the year has been DRY, as also have been the months of July, August, and September,—and that when the same first three months have been *wet* the year has been WET, and the months of July, August, and September also have been *wet*, with some exceptions.

I have not been able to discover any cause or sign for these exceptional years, but I may possibly in time. I have kept these papers

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by me for some years, hoping that in the course of my investigations I might discover something to clear up the difficulties.

Notwithstanding my inability to explain the exceptional years, I have determined to place the Tables before the Society, thinking that in a matter that has been so long occupying the attention of observers, even a step in the right direction might be of use, and induce others to follow in similar investigations.

I need scarcely allude to the value of such knowledge to the farmer as well as to those engaged in supplying large cities with water.

Table II.

When January, February, and March dry—July, August, and September, and the year, dry.

When January, February, and March wet—July, August, and September, and the year, wet, with exceptions.

	Year.	Difference in the Fall of Rain from the average.			Year.	Difference in the Fall of Rain from the average.		
		Jan., Feb., and Mar.	Twelve Months.	July, Aug., and Sept.		Jan., Feb., and Mar.	Twelve Months.	July, Aug., and Sept.
		ins.	ins.	ins.		ins.	ins.	ins.
	1825	−1·6	−2·1	−2·1	1816	+0·3	+2·9	+2·8
	1826	−1·1	−3·6	−0·1	1817	+1·2	+2·0	−0·1
	1827	−0·6	−1·9	−1·4	1821	+0·9	+6·9	+0·8
	1829	−2·6	−1·6	+3·9	1824	+0·1	+7·5	+1·7
	1834	−1·0	−6·7	+1·3	1828	+1·0	+4·1	+5·3
	1837	−0·4	−5·4	−0·6	1846	+0·4	+0·8	0·0
	1838	−1·3	−2·9	−4·0	1848	+2·1	+5·7	+1·4
	1840	−1·2	−7·9	−2·2	1860	0·0	+7·5	+2·3
	1842	−0·8	−1·7	+3·1	1866	+4·6	+6·1	+0·6
	1845	0·0	−2·1	−0·1	1867	+1·5	+3·9	+4·2
	1847	−1·2	−6·7	−3·0	Exceptions. 1819	+1·6	+2·8	−1·8
	1849	−0·5	−0·6	−0·6	1823	+1·2	+0·1	−0·4
	1850	−2·0	−4·8	−1·2	1831	+1·0	+3·4	−0·4
	1854	−1·7	−6·0	−2·0	1836	+0·5	+0·1	−0·3
	1855	−0·9	−3·4	−0·1	1844	+2·8	+0·4	−1·3
	1856	0·0	−2·3	−1·2	1862	+1·3	+1·9	−1·0
	1857	−1·2	−3·1	−0·2	1865	+1·3	+4·5	−0·8
	1858	−1·5	−7·3	−1·9	1868	+1·8	+0·7	−2·2
	1861	−0·5	−3·8	−3·0	1830	−0·7	+0·4	+1·2
	1863	−0·9	−4·5	−1·4	1839	−0·7	+2·4	+3·1
	1864	−2·2	−9·6	−2·8	1841	−0·1	+8·8	+2·5
Exceptions.	1822	−1·8	+0·7	0·0	1852	−0·1	+9·7	+3·2
	1843	−0·5	+0·1	−0·8	1853	−0·4	+4·5	+3·3
	1833	+0·4	−3·6	−2·5	1859	−1·8	+1·4	+0·9
	1835	+0·5	−1·7	−2·2				
	1851	+3·2	−2·9	−1·1				
	1818	+1·6	−1·1	−2·7				

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XLVI. *On the Height of the Barometer in relation to the Direction and Force of the Wind, at London.* By RICHARD STRACHAN, Esq., F.M.S.

If it be admitted that every wind has its weather, then a foreknowledge of the weather may be considered possible when the wind can be foretold, whether for brief or advanced periods of futurity. As regards the wind itself there are two things to take into account, the direction whence it comes and the force with which it blows. An inquiry might be instituted as to the indications of the wind's future proximate changes afforded by its veering and alteration of force during assumed intervals of time immediately preceding. In other words, the records of anemometers might be discussed with a view of deducing rules for foretelling wind-changes. Moreover, as the temperature of the air is an element of weather, the records of the thermometer might be consulted to ascertain whether it affords any indications, and under what circumstances, of the coming wind. Further, as the barometer shows that the weight or pressure of the air is subject to ceaseless fluctuation, inquiry may be made whether it can indicate the proximate changes of wind. The barometer has, indeed, been the recognized exponent of weather-changes, almost ever since its first invention, and numerous and various are the rules empirically put forth for the interpretation of its action and readings. It must be clear to any one who thinks about it that such rules can only be legitimately framed from careful investigations of records of barometrical observations conjoined with simultaneous observations of the wind's direction and force, or careful notation of the actual weather-conditions. This, no doubt, has been done to a great extent; but that it has *not* been *overdone* will, I imagine, be admitted by most meteorologists. In this manner it occurred to me that an investigation into the relation of barometrical pressure to the direction and force of wind would not be a work of supererogation, and might be attended with some interesting results. Accordingly I have collated the meteorological observations made by myself, in London, on a systematic plan, from November 1860 to the end of April 1869. The 9 A.M. observations being continuous were all used; and to them were added those taken at other hours when the force of wind was what is termed a gale or storm, because there was a deficiency of observations for strong winds, which these additions even have not made numerous enough.

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It may be well to state at the outset that all the barometrical observations had been reduced to 32° Fahr. and the sea-level, that the direction of the wind was always carefully taken by true and not compass bearings, and that grades of force were noted according to Admiral Sir F. Beaufort's scale, 0 to 12. I have not been in the habit of making special records of storms, and, consequently, I have very few entries of forces 10, 11, and 12. What I have, have been lumped together under 10.

In the first place the barometrical observations were grouped according to the months, for each grade of wind force, and under each of the sixteen principal points of the horizon in which they occurred. From these groupings it was manifest that, with the same estimated force and direction of wind, the atmospheric pressure may at times be an inch and upwards higher than at others, irrespective of any particular direction or any particular force. Thus, with light winds, with which the barometer usually reads high, the following very low pressures occurred:—

Months.	Force 1.		Force 2.		Force 3.		Force 4.		Force 5.	
	P.	W.	P.	W.	P.	W.	P.	W.	P.	W.
January	29·04	E.S.E.	29·18	W.	29·08	S.W.	29·02	W.	29·10	E.N.E.
February ...	29·45	N.	28·90	W.S.W.	29·17	S.	29·22	N.	29·24	S.
March	29·05	S.	29·15	E.S.E.	29·13	N.N.E.	29·45	S.E.	29·13	W.S.W.
April	29·70	E.	29·45	N.	29·49	W.	29·64	W.	29·78	N.
May	29·54	N.E.	29·56	N.N.W.	29·59	E.	29·50	E.	29·68	W.S.W.
June	29·70	E.	29·51	W.	29·31	E.	29·48	S.	29·47	W.
July	29·68	S.S.E.	29·50	W.	29·58	S.S.E.	29·34	S.S.W.	29·43	W.
August	29·55	S.S.W.	29·36	W.S.W.	29·41	S.S.E.	29·51	W.	29·53	W.
September ...	29·55	E.	29·38	S.S.W.	28·99	W.S.W.	29·22	S.W.	29·24	S.W.
October	29·35	S.W.	29·03	E.	29·18	S.E.	29·06	W.S.W.	29·25	W.
November ...	28·80	W.S.W.	29·29	W.N.W.	28·78	S.W.	29·38	S.S.W.	29·39	W.N.W.
December ...	29·89	E.N.E.	28·97	S.S.E.	29·41	W.	29·57	S.W.	29·29	W.
Lowest of all	28·80	W.S.W.	28·90	W.S.W.	28·78	S.W.	29·02	W.	29·10	E.N.E.

In this Table, except N.W., all the directions of wind are represented. Winds with westing are represented 33 times; winds with easting, 19 times. Considering the winds with southing and northing, the numbers are 29 and 11 respectively. Hence light and moderate winds with southing and westing are more frequently accompanied with low pressures than any other direction of winds having similar force, and they are also subject to the lowest of all pressures.

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Strong winds are, on the whole, usually attended by lower pressures than light winds; nevertheless the groupings revealed instances of high pressure under every direction of such winds, and showed differences of pressure for winds of the same direction and force equally as great as those exhibited for the light winds. Thus, with strong winds, the following high pressures occurred:—

Months.	Force 6.		Force 7.		Force 8.		Force 9.		Force 10.	
	P.	W.	P.	W.	P.	W.	P.	W.	P.	W.
January	30·31	S.W.	30·01	E.	29·89	S.W.	29·72	S.S.W.	29·75	W.S.W.
February	30·28	W.	30·24	N.	29·85	W.	29·95	W.	29·35	W.S.W.
March	30·09	W.	29·99	N.W.	29·93	E.	29·77	E.		
April	30·27	E.	30·45	E.	30·12	W.	29·70	W.		
May	30·00	S.W.	30·27	W.	29·94	E.				
June	29·89	S.S.W.	.....	.....	29·72	S.W.				
July	30·31	N.N.E.	29·82	S.W.						
August	29·99	W.	30·18	N.W.	29·86	W.				
September	30·15	N.E.	29·91	W.S.W.	29·57	S.W.				
October	30·36	E.S.E.	30·23	E.	29·92	S.W.	29·91	S.S.W.		
November	30·22	W.	29·90	E.	30·00	W.	29·67	S.W.	29·30	S.W.
December	30·45	E.N.E.	30·05	S.W.	30·17	S.W.	29·77	S.S.W.	30·07	W.
Highest of all	30·45	E.N.E.	30·45	E.	30·17	S.W.	29·95	W.	30·07	W.

In this Table, winds from S. to S.E. are not represented at all. Winds with westing occur 32 times; with easting, 12 times; with southing, 19 times; and with northing, 6 times. Hence it seems that strong winds with southing and westing are more frequently accompanied by high pressure than similar winds from other directions; but we must also recollect that the wind blows most frequently from between S. and W. The highest pressures, in this class, are apparently due to easterly winds. It is also noticeable that, with the strongest winds (force 8 and upwards), instances of the pressure amounting to 30 inches are certainly rare.

The next step was to take the averages of the monthly groups. These averages did not appear to afford any indication of a law connecting the atmospheric pressure with the various directions of winds having the same grade of force, probably because the observations, so numerously classed or subdivided, were in each case too few for the purpose. When, however, the total observations of pressure for each grade of force of wind were meaned according to direction, annual or general averages resulted which

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appear worthy of some consideration. They are given in the following Table:—

Observations of Wind referred to Sixteen Points.

Force 0–12; O. = number of observations; P. = pressure.

Force.	N.		N.N.E.		N.E.		E.N.E.	
	O.	P.	O.	P.	O.	P.	O.	P.
1	63	30·11	21	30·09	61	30·06	30	30·08
2	59	30·04	46	30·08	53	30·08	45	30·05
3	38	30·06	23	30·13	42	30·09	21	29·96
4	25	30·00	15	30·02	40	30·12	15	29·99
5	9	30·02	4	30·18	7	30·23	7	29·93
6	4	29·78	5	30·06	6	29·84	4	29·80
7	6	29·77	1	30·24	...	.....	1	29·99
8	1	29·49	...	.....	...	.....	1	29·94
9	1	29·87	...	.....	...	.....	...	.....
10 to 12.....	...	.....	...	.....	...	.....	...	.....
Total	206	30·04	115	30·09	209	30·08	124	30·02
Total referred to 8 points	310	30·06	...	.....	329	30·07	...	.....

Force.	E.		E.S.E.		S.E.		S.S.E.	
	O.	P.	O.	P.	O.	P.	O.	P.
1	96	30·04	15	29·93	25	30·05	9	30·02
2	93	30·06	17	29·80	20	30·00	17	29·83
3	49	30·06	9	30·05	17	29·93	17	29·81
4	33	30·03	6	29·97	3	29·89	9	29·87
5	5	29·94	3	30·09	1	30·03	2	29·78
6	6	29·94	2	30·25	1	29·48	1	29·36
7	7	30·07	...	.....	...	.....	...	.....
8	1	29·93	...	.....	...	.....	...	.....
9	1	29·77	...	.....	...	.....	...	.....
10 to 12.....	...	.....	...	.....	...	.....	...	.....
Total	291	30·04	52	29·93	67	29·99	55	29·85
Total referred to 8 points	379	30·03	...	.....	120	29·95	...	.....

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Observations of Wind, referred to Sixteen Points (*continued*).

Force 0–12; O. = observations; P. = pressure.

Force.	S.		S.S.W.		S.W.		W.S.W.	
	O.	P.	O.	P.	O.	P.	O.	P.
1	53	30·00	16	29·97	38	30·00	44	29·96
2	42	29·88	29	29·82	78	29·98	77	29·97
3	31	29·73	26	29·79	62	29·94	65	29·92
4	10	29·75	19	29·73	66	29·87	49	29·83
5	8	29·59	9	29·86	35	29·86	25	29·74
6	13	29·64	6	29·71	33	29·86	27	29·60
7	3	29·66	3	29·64	24	29·68	21	29·69
8	1	29·25	3	29·62	16	29·64	6	29·51
9	1	29·30	5	29·64	12	29·39	2	29·61
10 to 12	...	.....	2	29·25	4	29·13	3	29·27
Total	162	29·84	118	29·79	368	29·87	319	29·85
Total referred to 8 points	249	29·83	...	.....	586	29.86	...	.....

Force.	W.		W.N.W.		N.W.		N.N.W.		Calm.	
	O.	P.	O.	P.	O.	P.	O.	P.	O.	P.
1	113	30·07	13	30·07	45	30·06	17	30·11	90	30·06
2	149	30·03	35	29·99	55	30·06	33	29·95		
3	95	29·96	35	29·98	40	30·00	21	30·08		
4	94	29·90	14	29·98	21	29·88	15	30·04		
5	43	29·83	12	29·88	11	29·98	5	30·12		
6	31	29·87	7	29·71	16	29·78	1	29·96		
7	14	29·73	4	29·52	7	29·87				
8	9	29·78	5	29·53	2	29·43				
9	5	29·52	1	29·34	2	29·32				
10 to 12	1	30·07	...	.....	...	.....				
Total	554	29·96	126	29·93	199	29·98	92	30·08		
Total referred to 8 points	777	29·94	...	.....	308	29·99				

The averages, shown graphically, approximate to curves, having their maxima about N.N.E. or N.E., and their minima at S. and S.S.W. Much of the irregularity of the tracings upon the accompanying diagram may be attributed to paucity of observations under certain directions of wind. The flattest curve appears to

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be with force 1, and the curvature seems to increase with the force. This tells us that there is more motion in the barometer with equatorial than with polar winds, for a given increase of force. The curve (D) of pressure for direction of wind, irrespective of force, is very similar to the others, and comes out more symmetrically when the observations are referred to eight points only of the compass (curve E).

The whole of the observations of the barometer were next grouped for each grade of the wind's force without regard to direction, with the following results, against which are placed similar results obtained by an investigator unknown to me, who worked up the observations made by Mr. Rogerson, at Greenwich, in 1835–36, and published a short paper on the subject in the 'Nautical Magazine' for 1853.

Force.	Years 1860–69.		Years 1835–36.	
	Pressure.	Observations.	Pressure.	Observations.
0.	30·06	90	.....	...
1.	30·03	659	30·19	109
2.	30·01	848	30·03	255
3.	29·97	591	29·98	355
4.	29·93	434	29·92	196
5.	29·90	186	29·87	247
6.	29·79	163	29·77	139
7.	29·74	91	29·67	82
8.	29·63	45	29·54	45
9.	29·49	30	29·49	14
10.	29·28	10	29·48	19

These two sets of results are shown graphically in the diagram, marked L and G respectively. They are in close accord with each other, and show a striking decrease in the average atmospheric pressure with the increase of the wind's force.

The average height of the barometer at London is 29·957 inches, from 3147 observations, the total number employed in this investigation. The resultant of all the observations of the wind's directions, irrespective of force, has been calculated, and found to be W. ½ S.

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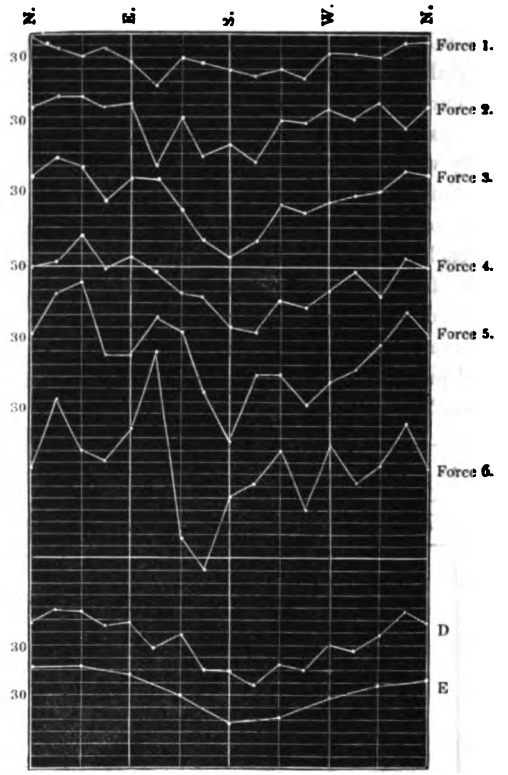
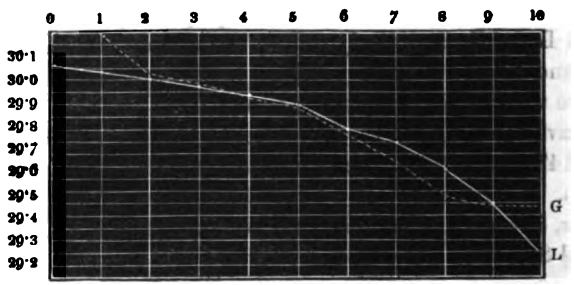


Grade of Force.



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ANNUAL GENERAL MEETING.

1869, JUNE 16.

The business of the Ordinary Meeting having terminated, the Annual General Meeting was held, and the following Report of the Council was received and read.

REPORT.

It is with pleasure the Council have to report the increased interest taken in meteorology all over the world; every expedition, whatever its principal object may be, is furnished with a more or less complete set of meteorological instruments. With respect to the meteorologists at home, the following list (showing the names of those gentlemen, in Mr. Glaisher's corps of observers, whose observations were unbroken during the year 1868) will speak for itself:—

Observer.	*Station.*
S. E. Hoskins, Esq., M.D., F.R.C.P., F.R.S., F.M.S.	Guernsey.
M. P. Moyle, Esq., M.R.C.S.	Helston.
C. Barham, Esq., M.D., F.M.S.	Truro.
J. Ingleby Mackenzie, Esq., M.B., F.M.S.	Sidmouth.
Thomas Mackrell, Esq.	Barnstaple.
J. R. Mann, Esq., M.D.	Osborne.
T. A. Compton, Esq., M.D., B.A., L.R.C.P.L., M.R.C.S.E., F.M.S.	Bournemouth.
Miss Wilhelmina L. Hall	Eastbourne.
W. J. Harris, Esq., M.R.C.S.E., F.M.S.	Worthing.
Thomas Challis, Esq.	Wilton.
Rev. F. W. Stow, M.A., F.M.S.	Tunbridge Wells.
John Arnold, M.S.C., F.M.S.	Aldershot Camp.
Rev. C. H. Griffith, M.A., F.M.S.	Strathfield Turgiss.
W. F. Harrison, Esq., F.M.S.	Weybridge Heath.
Charles P. Russell, Esq.	Bath.
Rev. T. A. Preston, M.A., F.M.S.	Marlborough College.
G. B. Airy, Esq., M.A., LL.D., D.C.L., F.R.S., F.M.S.	Greenwich.
Rev. J. Slatter, M.A., F.R.A.S., F.M.S.	Streatly Vicarage.
Henry E. Segrave, Esq., F.M.S.	London, N.W.
G. J. Symons, Esq., F.M.S.	London, N.W.
Rev. R. Main, M.A., F.R.S., F.R.A.S.	Oxford.
E. Toller, Esq., M.D.	Gloucester.
Hale Wortham, Esq., F.R.A.S., F.M.S.	Royston.

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Observer.	*Station.*
S. C. Whitbread, Esq., F.R.S., F.R.A.S., F.M.S.	Cardington.
Rev. Prof. J. Matthews, M.A.	Lampeter.
C. M. Gibson, Esq., F.M.S.	Norwich.
S. H. Miller, Esq., F.R.A.S.	Wisbech.
James Nicol, Esq., M.D.	Llandudno.
J. W. Jeans, Esq., M.R.C.S., F.R.A.S., F.M.S.	Grantham.
John Davis, Esq.	Derby.
John Davidson, Esq.	Holkham.
M. O. Tarbotton, Esq., C.E., F.G.S., F.M.S.	Nottingham.
A. Mercer Adam, Esq., M.D., F.M.S.	Boston.
T. Moffat, Esq., M.D., F.R.A.S., F.G.S.	Hawarden.
T. Mackereth, Esq., F.R.A.S., F.M.S.	Eccles.
Louis J. Crossley, Esq, M.R.I., F.M.S.... / Joseph Gledhill, Esq., F.G.S., F.M.S.....	Halifax.
Mr. E. Peak	Hull.
Rev. S. J. Perry, M.A., F.R.A.S., F.M.S.	Stonyhurst.
Henry Denny, Esq., A.L.S.	Leeds.
H. W. Thorns, Esq.	Otley.
Fielden Thorpe, Esq.	York.
Rev. F. W. Stow, M.A. F.M.S.	Ripon.
H. Dodgson, Esq., M.D., F.R.A.S., F.M.S.	Cockermouth.
T. Sopwith, Esq., M.A., F.R.S., F.G.S., F.M.S.	Allenheads.
Rev. F. Redford, M.A., F.R.A.S., F.M.S.	Silloth.
Isaac Cartmell, Esq., F.M.S.	Carlisle.
T. Sopwith, Esq., M.A., F.R.S., F.G.S., F.M.S.	Bywell.
Robert Spence, Esq.	North Shields.
J. Smyth, jun., Esq., M.A., M.I.C.E.I., F.M.S.	Milltown.
A. Forbes, Esq., F.M.S.	Culloden.

Being fifty-one in number; of these thirty-two are Fellows of this Society.

The following are the names of observers whose observations were not complete for 1868, owing to several causes:—

W. Stuart Falls, Esq., M.D., F.M.S., Bournemouth, deficient of the months of May, June, July, August, September, November, and December.

Rev. W. Tuckwell, F.M.S., Taunton, deficient of one month, viz. June; and the results for April, with the exception of the rain, could not be published.

W. Haywood, Esq., C.E., Guildhall, deficient of the three months March, May, and June.

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Rev. J. P. Faunthorpe, B.A., F.R.G.S., Battersea Training College, deficient of the months January, July, and August; and the results for December, with the exception of the rainfall, could not be published.

G. V. Vernon, Esq., F.R.A.S., F.M.S., F.A.S.L., Manchester, deficient of the months April, May, June, July, August, and September.

John Hartnup, jun., Esq., F.R.A.S., Liverpool, deficient of one month, viz. September.

The following alterations in the list of observers took place from December 31st, 1867, to December 31st, 1868:—

C. H. Weston, Esq., B.A., F.R.A.S., F.G.S., Ensleigh, Lansdowne, has discontinued forwarding the monthly sheets of observations since June 1868.

G. F. Burder, Esq., M.D., F.M.S., Clifton, has ceased observing since March 1868, owing to ill health.

Rev. F. Silver, M.A., F.R.A.S., F.M.S., Norton-in-Hales, has ceased forwarding the monthly sheets of observations since April 1868.

The observations taken at Kingsley Parsonage were discontinued in June 1868, the Rev. R. Tyas, M.A., LL.D., F.M.S., having removed to West Harptre Vicarage, near Bristol, where observations are now taken.

Owing to the death of W. R. Milner, Esq., M.R.C.S., F.M.S., &c., the observations at Wakefield Prison have been discontinued since July 1868.

The observations for Halifax are now taken at Willow Hall, situated about half a mile from the town, instead of at King's Cross, Halifax; they are still taken, however, by the same observer, Joseph Gledhill, Esq., F.G.S., F.M.S.

The staff of observers numbers sixty (at the end of March 1869); of these thirty-eight are Fellows of this Society, and the remaining twenty-two are chiefly Fellows of other Societies.

The weekly meteorological observations from the following large towns have been forwarded very regularly for the Registrar General's weekly Report:—Over Court (near Bristol), Birmingham, Liverpool, Manchester, Eccles, Sheffield, Hull, and Newcastle-upon-Tyne. The observations taken at Wakefield, and supplied for Leeds, are discontinued, the observations being taken at Leeds by E. Filliter, Esq., C.E. Observations are also forwarded from Bradfordby J. M^{c}Landsborough, Esq., C.E., F.G.S., F.M.S. No other alteration has taken place since the last Report.

Turning to the papers which have been read before the Society at the several meetings during the past year, the first was by George Dines, Esq., "On the Rainfall," &c.: this is a subject

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which was also treated by James Glaisher, Esq., at our April Meeting, and again by Mr. Dines at the same Meeting. The latter gentleman, in his last paper, states that, although strongly prejudiced to the contrary, he is obliged to come to the conclusion expressed in his former paper, "*that the fall of rain is in no way influenced by the changes of the moon or the moon's age.*" Mr. Glaisher, on the other hand, arrives at the conclusion that the results given by the observations made at the Royal Observatory, Greenwich, and extending over a period of fifty-four years, "*show a lunar influence.*" Alexander Brown, Esq., and M. Connal, Esq., have had papers on the subject of rainfall—the former a paper "On the Rainfall of Arbroath for Twenty-six Years," and the latter a paper read at our last Meeting, "On the Rainfall of Mauritius," in which he states that the *wet* season at that colony extends from December to April, and the *dry* from May to November. The papers on storms are:—by R. J. Mann, Esq., "On an exceptionally heavy Rainfall and a destructive flood in the Colony of Natal, in the month of August 1868;" by R. H. Twigg, Esq., "On the Storm of the 8th and 9th of September, 1867, at Sombrero;" and by James Glaisher, Esq., "On the Storm of February 12th, 1869." The Rev. F. W. Stow, M.A., in a paper "On Comparative observations of Solar Radiation," recommends the use of "a solar-radiation thermometer, *in vacuo*, in which the bulb and 1 inch of the stem are covered with lamp-black, placed at a distance of 4 feet above the ground." During the Session, C. O. F. Cator, Esq., laid before the Society a description of his anemometer arranged with spiral apparatus, and F. Pastorelli, Esq., brought forward the method adopted for dividing alcohol minimum-thermometers. F. W. Doggett, Esq., favoured us with two papers, one "On the Weather in connexion with the crop of Hops of the year 1868," and the other on "Weather Signs." Mr. Meldrum's papers "On the connexion between the Rotation of the Wind in the Southern Indian Ocean and the relative positions of oppositely directed Air-currents," are of great interest, and the subject is one deserving of the fullest investigation. There is a paper for reducing barometer-readings to the level of the sea, by the Rev. W. Previté.

Royal Observatory, Greenwich.—No alteration has been made during the past year in the Magnetic Observatory, and the magnetic instruments are in an efficient state. The earth-current wires from the Observatory to Croydon, and to Dartford, have been abandoned; and, in their stead, wires now run from Angerstein Wharf to Lady-Well, and from North Kent Junction to Morden College Tunnel. At each of these points earth-connexions are made by copper plates. The straight lines connecting these N.–S and W.–E. points, intersect each other at very nearly right angles, at a little distance from the Observatory; but great length is necessarily added to the wires by following the railways to their junction in order to lead the wires through the

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registering apparatus in the Observatory. This arrangement was brought into effective operation on August 20, 1868, and is proposed to be maintained for two or three years, when the register of earth-currents will probably be discontinued, unless some new points should present themselves for examination, or the establishment of similar apparatus in other observatories should render the cooperation of the Royal Observatory desirable.

In mentioning, last year, the results obtained from the comparison on seventeen days of the magnetic-disturbing forces due to the spontaneous galvanic currents with the magnetic disturbances actually observed, it was stated that the comparison was about to be extended to all the disturbed days which had occurred during the use of the apparatus in the years 1865–67, and that the undisturbed days would also be examined. This plan has been carried out, first, by extending the comparison to thirty-six additional disturbed days (making fifty-three in all), for five of which the curves of comparison have been drawn, giving sensibly the same character as that derived from the seventeen previous days. Secondly, the indications for the whole of the undisturbed days have been reduced, and their diurnal inequalities for each month laid down in curves; their dimensions are extremely small, and follow a law totally different from that of ordinary magnetic diurnal inequalities, having greater resemblance to the curve which would best represent lunar-diurnal inequalities. The important negative result is thus obtained, that the ordinary diurnal inequalities of the magnet cannot be explained by the spontaneous galvanic currents.

The dip and deflexion instruments are in good order, and the action of the former is so delicate and certain that it is proposed to recommence the system of observation at different hours of the day, which was commenced, but brought to a close many years ago.

The mean westerly declination of the magnet for 1868 was found to be 20° 13′, the mean value of horizontal force in English units 3·854, or in French units 1·777, and the mean dip 67° 56′ 31″. By the use of the needles of different lengths in the dip-instrument, it has been found that the value obtained is related to the dimensions of the needle employed; the separate values in the year 1868 are:—

By 9-inch needle.....	67°	54′	53″
6-inch „	67	56	39
3-inch „	67	58	0

Turning now to the meteorological department of the Observatory, we find that every branch of meteorological science (with the exception, perhaps, of atmospheric electricity) has been carefully and effectively attended to, whether by photography (by means of which the changes of the barometer, and dry- and wet-bulb thermometers are registered), by automatic pencil re-

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gistration (as is the case with the direction, pressure, and velocity of the wind, and the rainfall), or by continual eye-observation, for which are provided ample means in the shape of barometer, ordinary thermometers (dry and wet) at 4 feet and 22 feet above the surface of the ground, radiation-thermometers, thermometers at different depths in the ground, thermometers in the water of the Thames, seven pluviometers at different elevations, and ozonometers.

It is satisfactory to learn that steps are now about to be taken for the systematic reduction of the photographic records of atmospheric and evaporation temperature for the past twenty-one years; and it may be fairly hoped that, from the reduction of this mass of valuable records, information of the utmost value will be obtained with regard to the various laws of meteorological change.

Adverting now, with due regard to brevity, to special meteorological phenomena observed since the date of our last Report, we have first to draw attention to the extraordinary heat and drought of the summer months; and it may be noticed that the highest temperature in the year, viz. 96°·6 on July 22, was higher than any value that had previously been recorded at the Observatory as far back as authentic records extend. The maximum daily temperature exceeded 92° on July 16, 21, and September 7, and was between 90° and 91° on July 20, 28, and August 5. The following instances were the most remarkable in the extraordinary series of high mean daily temperatures, namely 77°·9 on July 22, being 16°·4 above the average, 76°·6 on July 21, 75°·9 on July 16, 74°·4 on July 28, 74°·2 on August 5, 74° on July 27, 73°·2 on September 7, and 73°·2 on August 4; and these values, as compared with the corresponding average values are higher by the respective amounts of 15°·1, 13°·5, 12°·2, 12°, 12°, 15°·4, and 10°·9. The recorded value on July 22nd (77°·9) has only been exceeded on *four* occasions in the preceding fifty-three years, viz. on July 24th, 1818, when the mean temperature was 79°·2, and on July 15th, 18th, and 19th in the year 1825, when the mean temperatures were respectively 79°·1, 78°·2, and 78°·6. The previous references which we have made to average values have been to those deduced from fifty years' observations; but we have a longer series with which monthly means can be compared, viz. ninety-seven years. The mean for the month of July, as compared with this ninety-seven years' average, was in excess to the amount of 6°·1, the mean for the three months May, June, and July in excess to the amount of 4°·9, and the mean for the eight months from February 1868 to September, was in excess to the amount of 4°.

The warmth of the season is thus seen to have been excessive; and that the drought during a long period was no less remarkable may be partly gathered from the fact that the rainfall for the seven months, May to November, was deficient to the amount of

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5·9 inches; but the great dryness that prevailed, may be more certainly seen by an examination of the deduced values of the degree of atmospheric humidity, both during monthly periods and also on special days. It will then be seen that the monthly values were below their averages in the months June to September to the mean amount of 8, that the value for July, viz. 63, was no less than 13 below the average, and that on July 21 and 22 the degree of humidity was 49 only, and on July 31 it was 55.

A somewhat cold autumn followed this remarkably hot summer, and was in turn followed by a very stormy winter of exceptionally mild and damp nature.

South-westerly gales of violent character were frequently experienced, too numerous, however, to be noticed in detail: the rainfall in the months of December 1868 and January 1869 exceeded the average by 1·9 inch; and the mean monthly excess of temperature above the average for the months December to February was nearly 5°. The month of March was cold throughout, the deficiency of temperature amounting to 4°; April, on the contrary, was fine and warm, and its excess of mean temperature amounted to 3½°. The unusual predominance of N.E. winds in the month of May (as in March also) caused the month to be cold, and the deficiency of temperature was 2½°, while rain fell on twenty-one days to the amount of 3·43 inches, being as much as 1·27 in. in excess.

The only further special remark needed with regard to April and May is, that brilliant auroræ were seen on the 15th of April and 13th of May, and were accompanied by very active disturbance of the magnetic instruments.

Royal Observatory, Edinburgh. C. Piazzi Smyth, Astronomer Royal.—During the past year nothing has been done beyond the usual and regular meteorological work, viz. reducing the observations of fifty-five stations of the Meteorological Society of Scotland, distributed throughout Scotland and the adjacent islands, for the monthly and quarterly publications of the Registrar-General of Scotland, observing the underground thermometers at depths of from 3 to nearly 300 inches below the soil, and keeping up a small meteorological journal connected with clock-rates.

Cambridge Observatory. Professor Adams.—The meteorological work of this Observatory consisted of daily readings, at 9 A.M. and 3 P.M., of the barometer, dry- and wet-bulb thermometers, maximum and minimum thermometers, velocity of wind as registered by anemometer, the direction of wind from a graduated circle attached to the vane, and the rain as measured by one of Casella's gauges. The maximum and minimum thermometers

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having caused some trouble (in consequence of the former suffering from oxidation, so that the motion of the index was sometimes interfered with, and the column of spirit in the latter not unfrequently breaking up into portions, which were with difficulty reunited), were replaced by new ones, which were carefully compared with a certificated standard thermometer belonging to Mr. Pain, F.M.S. The anemometer has been out of order more than once during the past year, in consequence of the formation of ice in the interior of the box containing the wheelwork, by which the wheels have been stopped and their teeth injured. Measures have been taken to prevent the accumulation of moisture in the interior. With the exception of these interruptions, the meteorological observations have been punctually registered.

The observations have been reduced as usual by means of 'Glaisher's Hygrometrical Tables.'

A few special observations were made of the barometer for the Rev. W. Previté, of Little Wratting, Haverhill, for the determination of the height of his barometer above the sea-level.

Radcliffe Observatory, Oxford. Rev. R. Main, M.A., F.R.S., &c.—Under the able superintendence of Mr. Lucas the meteorological observations at this Observatory have been carried on during the past year with the same regularity and success as in former years. Additional advantage has been taken of the tower of the Observatory, by placing on the top of it a maximum and minimum wet-bulb thermometer side by side with the thermometer which determines the temperature of the air, for determining whether the hygrometrical conditions of the atmosphere are sensibly different at this elevation from those near the surface of the ground. The same attention is paid as in former years to the photographical observations of the velocity and direction of the wind; and a recent investigation by Mr. Baxendell, of Manchester, based on these observations, has led to the discovery of a curious law in the average diurnal changes of velocity and direction.

Through the kindness of Balfour Stewart, Esq., M.A., LL.D., F.R.S., the Observatory has been recently supplied with a quantity of waxed papers ready for use; and the saving of time and labour which is thus produced is of very great value in an Observatory with so small a force of assistants in proportion to the amount of work which is regularly performed and published.

Liverpool Observatory, Bidston, Birkenhead. J. Hartnup, jun., Esq., F.R.A.S.—No change has taken place at this Observatory during the past year in recording meteorological observations. The direction, force, and horizontal motion of the air,

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the fall of rain, and the pressure of the atmosphere have been tabulated from daily records of the self-registering instruments for each hour throughout the year. Maximum and minimum thermometers have been read at 9 A.M. daily, and wet- and dry-bulb at 9 A.M. and 3 P.M. The arrangements for testing nautical instruments being now complete, those chronometers belonging to ships which pay dues to the Mersey-Dock Estate are received at the New Observatory and tested for five weeks in temperatures ranged in the following order—55°, 70°, 85°, 70°, 55°—free of all charge to the owners or masters of the ships to whom they belong. New chronometers are received from the makers in such numbers as the Directors of the Observatory may, from time to time, decide on; and certificates of test, showing the daily rates during each of the five weeks, signed by the astronomer, are supplied free of all charge to the makers.

NATAL.—During the past year, rainfall, temperature, and air-pressure observations have been continued at Dr. Mann's observatory in this colony. It has, however, only been found possible during Dr. Mann's extended absence in England upon public service, to secure more than records of air-pressure and temperature at 9 A.M., and of the maximum and minimum temperatures and rainfall for each day. A good series of comparative rainfall for the Observatory (fifty miles in the interior, with an elevation of 2050 feet) and for the coast has, however, been made available; and the leading facts bearing upon thunderstorms and the remarkable hot winds have been recorded. The most desirable object, of establishing stations of meteorological record on the various steps of this threshold of the great African continent, at elevations of the sea-level, 2000 feet (Maritzburg), 5000 feet (the Karkloof), and upon the plateau of the Orange River Souresgatz, the true South-African tableland above the Drakenbergen, yet remains to be accomplished, as a most efficient and interesting means of investigating the great laws of atmospheric movement and conditions where the moist trade-wind of the Indian Sea thus rushes suddenly upon the abruptly ascending slope of a great sun-scorched continent. It is hoped that this interesting work will be undertaken with some measure of completeness and permanence when the young colonial state has made some little further advance in material prosperity, and has escaped from the pressure of recent commercial reverses.

RAINFALL-INVESTIGATIONS.—The yearly increasing number of observers (now exceeding 1500), and the additional details which they are now expected to furnish, render the work of examining

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and tabulating the current returns a very different matter from what it was ten years since, when there were scarcely one-tenth the present number of stations, when Wales had seven stations instead of ninety-five, and Ireland sixteen instead of seventy-two. The current work is, however, kept well in hand; and very considerable progress has been made with the collection of old observations. This last portion of the work is one in which probably every Fellow of this Society could help; for almost every one possesses either some old MS. observations, or printed tables of rainfall in published or privately printed books; and though many of them may have already been copied, many doubtless have not, and it would materially assist if the Fellows of this Society would notify to Mr. Symons what returns they possess, so that, if previously copied, duplicate copying might be avoided.

The investigation into the percentage of the total yearly amount falling in the several months, which was commenced some years since by Mr. Symons, has been continued and (for the present) concluded by Mr. Gaster, and the results have been published. We say that the inquiry has been concluded "for the present," because as soon as the decade 1860–69 is completed, it will, owing to the larger number of stations, afford excellent *data* for comparison with those previous decades which have been already discussed.

The various experimental gauges at Strathfield Turgiss (numbering no less than forty-two) are in efficient order and most carefully observed by the Rev. C. H. Griffith, F.M.S. Those also with inclined, rotating, and tipping funnels, erected at Rotherham by R. Chrimes, Esq., are in satisfactory operation, and the results are undergoing examination by the Rev. J. M. Du Port, M.A.

The examination of rain-gauges, *in situ*, and the determination of their correct altitude above mean sea-level has been steadily continued whenever opportunity offered; and Mr. Symons reports that he has now visited a total number of 317.

Temperature of the Earth at Great Depths.—The correlation of the various branches of scientific research has had a somewhat marked illustration in the controversy between Sir William Thomson and Professor Huxley on the subject of "Geological Time." This subject, as is generally known, largely depends on the rate of increase of temperature at different depths in the crust of the earth. Until the last few years scarcely any experiments as to temperature at great depths had been made, except in the shafts and workings of mines, where the temperature would be more or less affected by (1) currents of air, (2) streams of water, (3) the warmth of men, horses, lamps, blastings, &c. Therefore, when the British Association appointed a committee to investigate the matter, it was resolved, as far as possible, to obtain other

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modes of access to great depths. One of these is in the northern suburbs of London, near the foot of Highgate Hill, where, for water-supply purposes, a hole 1 foot in diameter was bored to a vertical depth of nearly a quarter of a mile; and this bore has been placed by the New-River Company at the disposal of Mr. Symons, a member of the British-Association Committee. The necessary mechanical and instrumental appliances having been provided, observations commenced January 1, 1869, and have been regularly continued up to the present time, and will be carried on for at least six months longer. Not being yet concluded, the results obtained can only be accepted *ad interim*; but they appear to show:—

1. That, the surface temperature being 49°, the temperature at 1100 feet is 69°·7, being a rise of 1° for each 53 feet.
2. That the temperature rises almost exactly 100° for each mile of depth.
3. That the rate of increase is constant.

A matter was brought by Lieut.-Colonel Strange, F.R.S. and Foreign Secretary of the Meteorological Society, before the Mathematical and Physical Section of the last Meeting of the British Association for the Advancement of Science, held at Norwich, which possesses a direct and immediate bearing on meteorological science, and is therefore worthy of passing notice and record. Colonel Strange, after an extended series of years spent on one very important branch of scientific research, the examination and perfecting scientific instruments and observational appliances, has been led to the conclusion that the advance of physical science is very materially impeded by the want of ready facilities for physical observation and investigation. He is convinced that in the present state of affairs there is a most lamentable waste both of capable and available intellectual power, and of instrumental means, which might be turned to excellent account under better arrangements. The Colonel himself holds the view that it ought certainly to be the part of a good government to provide for the prosecution of physical science as one of the most powerful engines of social amelioration and development. But in the face of this grave difficulty of determining how state aid may be most efficiently and most satisfactorily secured for this great object, he has proposed, in the first instance, an investigation of the entire subject of extending the existing facilities for physical investigation by a Committee of the British Association for the Advancement of Science, which has been formed, and which consists of:—

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Lieut.-Col. Strange, F.R.S.
Prof. Sir William Thomson, F.R.S.
Prof. Tyndall, F.R.S.
Prof. Frankland, F.R.S.
Prof. Williamson, F.R.S.
Prof. Stokes, F.R.S.
Prof. Fleeming Jenkin, C.E., F.R.S.
Prof. Hirst, F.R.S.
Prof. Huxley, F.R.S.
Dr. Balfour Stewart, F.R.S., F.M.S.
Dr. Mann, F.R.A.S., F.M.S.
Dr. Stenhouse, F.R.S.
James Glaisher, Esq., F.R.S., F.M.S.
William Huggins, Esq., F.R.S., F.M.S.

It is hoped that the beneficial action of this Committee will be extended and matured by the ultimate appointment of a Royal Commission to deal with the entire subject, and that the meteorological branch of physical science, dealing so largely, as it is constrained to do, with extensive and sustained accurate observation and record, will be most materially benefited by the movement.

A New Polar Expedition.—James Lamont, Esq., of Knockdow, late member for Buteshire, author of 'Seasons with the Sea-Horses,' who has made two previous Arctic voyages, has had a steam-yacht built, at a cost of £12,000, for a Polar exploring expedition. The yacht, named the 'Diana,' is equipped with every requisite for such a cruise, and provisioned for more than a year. Mr. William Livesay, a third-years' student of the University of Edinburgh, where he has taken the highest honours in the classes of anatomy, chemistry, and botany, and an undergraduate of the University of London in the first class (brother of one of our Fellows, and son of Augustus F. Livesay, Esq., of Portsmouth), accompanies the expedition as artist and journalist, and will assist Dr. Smith in making collections to illustrate the natural history of those portions of the Arctic regions which the 'Diana' may visit. Mr. Livesay, guided by the advice of our President, has taken a set of meteorological instruments purposely constructed by Mr. Zambra. In the event of the ship getting locked for the winter, a series of meteorological observations will be taken on the ice, which it is expected will prove of great value to science.

The Council, in conclusion, wish to state that they think the Society has established a claim to receive accommodation from Government equal to that which they have provided or undertaken to provide for other Societies; and they hope that before the end of this Session, the Society will have its own rooms, in recognition of its services by Government.

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The present strength of the Society is as follows:—

Life Fellows	65
Ordinary Fellows	258
Honorary Fellows	7
Total	330

The Society has to regret the loss of several of its Fellows; the deceased Fellows are:—

Lieut.-Colonel Henry Austen, who was elected into the Society on November 18, 1863.

Sir Charles Wentworth Dilke, Bart., F.R.G.S., F.S.A., F.R.H.S., elected June 4, 1850.

William Ralph Milner, Esq., M.R.C.S., F.R.M.S., elected May 7, 1850.

H. E. Westcar, Esq., elected April 18, 1866.

Sir Charles Wentworth Dilke, Bart., F.R.G.S., F.S.A., F.R.H.S., was the only son of Mr. Charles W. Dilke, chief proprietor, and some time editor of the 'Athenæum,' a critic whose writings on Pope, on Burke, and on Junius are known to all students of our literary and political history. The deceased baronet was born on the 18th of February, 1810, and was educated at Westminster and at Trinity Hall, Cambridge. For a short time he studied law, in which he took his degree; but afterwards gave up his leisure to the affairs of three or four of the learned societies. He took a prominent part in the Society of Arts (of which he was for some years Chairman of Council), and also in the Royal Horticultural Society. At the boards of these Societies he became acquainted with the Prince Consort, whom he assisted in carrying out many of the great schemes for public improvement which are associated with the Prince's name. He was one of the first projectors of the Great Exhibition of 1851, and acted as a member of the Executive Committee. On the conclusion of that brilliant success he was loaded with the favours of foreign countries and sovereigns, and was offered by our Queen the honour of knighthood, and by the Royal Commission a large pecuniary reward. The knighthood he declined, and the gift of money he refused.

In 1853 he was appointed, by the Crown, one of the Commissioners to represent this country at the American Industrial Exhibition in New York. A special Report, which he prepared, was presented to the House of Commons and ordered to be printed in the following year. As in the case of his previous labours, he declined any compensation.

When the second great Exhibition (that of 1862) was proposed, the Government appointed him one of the five Royal Commis-

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sioners for conducting it; and on the Prince Consort's unexpected demise, Her Majesty conferred upon him the honour of a Baronetcy. Sir C. W. Dilke entered Parliament in 1865 as Member for Wallingford. He was a Justice of the Peace for the county of Middlesex, a Fellow of the Society of Antiquaries, a Fellow of the Meteorological Society (of which he was one of the oldest Members, having joined on June 4, 1850), a Fellow of the Royal Geographical Society, a Trustee of the Soane Museum, and an active member of many other public and learned bodies.

For some time past he had been in failing health, and his friends had hoped that the trip to Russia (in which country he was when he died) would do him good; but the extreme inclemency of the weather in the north of Europe aggravated his disease, and he died on Monday, May 10, 1869.

W. Ralph Milner, Esq., M.R.C.S., &c., was the son of Mr. Ralph Milner, a native of Wakefield, and was born in London, at or about Thavies Inn, on the 27th of April, 1810. In 1838 Mr. Milner became a Member of the Royal College of Surgeons in London. In September 1847 he was appointed surgeon to the new convict department at Wakefield House of Correction. He held the appointment until March 1867, when the Government convicts were removed from Wakefield, and he received a pension in consideration of past services. He was appointed with Dr. Edward Smith to prepare an essay on prison diet. This was deemed very valuable, and was printed for public use. He promoted many improvements within the prison, gave much attention to drainage and water-supply, and to all other matters affecting health. He experimented largely, and with good results, touching the food of prisoners: one of his processes was to ascertain monthly the weight of each person under confinement, loss of weight being, he said, a certain indication of change of health. He was also at this time an accurate observer and recorder of meteorological phenomena, for which facilities were afforded him within the prison walls.

It would be tedious to mention the numerous public societies, such as the Meteorological Society (of which he was one of the oldest Members, having joined at its formation on May 7, 1850), Royal Microscopical, Ray, and Anthropological Societies, with which Mr. Milner was connected. His subscription was ready for any good thing of the kind.

He had for many years past been looked up to as practically the head man in his profession at Wakefield; and he willingly gave his help and advice to his brethren in medicine whenever they asked for it. He died on Monday, the 17th of August, 1868, in his 59th year.

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The following Papers were read at the Ordinary Meetings during the Session 1868–69:—

1. "On the Rainfall of Cobham and Chiswick." By G. Dines, Esq., F.M.S.

2. "On an exceptionally Heavy Rainfall and Destructive Flood in the Colony of Natal, in the Month of August 1868." By R. J. Mann, Esq., M.D., F.R.A.S., F.R.G.S., F.M.S.

3. "November Meteors, 1868." By James Glaisher, Esq., F.R.S., President.

4. "A Journal of Natural Appearances and Occurrences in Farming, with some occasional Remarks on the Weather &c., made at Farningham, near Dartford, Kent, until Michaelmas 1817, and since at Trevereux, near Limpsfield, Surrey." By Henry Cox, Esq.

5. "The Weather in connexion with the Crop of Hops of the Year 1868." By F. W. Doggett, Esq., F.M.S.

6. "On Reducing the Barometric Readings to the Sea-level." By the Rev. W. Previté, M.A., F.M.S., Little Wratting, Suffolk.

7. "On the Method adopted for Dividing Alcohol Minimum-Thermometers." By F. Pastorelli, Esq., F.M.S.

8. "On the Storm of the 8th and 9th of September, 1867, at Sombrero." By R. H. Twigg, Esq., C.E., F.M.S.

9. "Description of Mr. Cator's Anemometer as newly arranged with Spiral apparatus, and its Registrations from the 11th of September, 1868, to the 11th of February, 1869." By C. O. F. Cator, Esq., M.A., F.M.S.

10. "On the Connexion between the Rotation of the Wind in the Southern Indian Ocean and the Relative Positions of oppositely directed Air-currents." By Charles Meldrum, Esq., M.A., F.M.S.

11. "Results from Meteorological Observations made at the Royal Observatory, Cape of Good Hope, from 1st of January, 1842, to 31st of December, 1861." By Sir T. Maclear.

12. "The Rainfall at Arbroath (latitude 56° 33′ 35″ N., longitude 2° 35′ 30″ W. of Greenwich) for Twenty-six Years." By Alexander Brown, Esq.

13. "On the Storm of February 12, 1869." By James Glaisher, Esq., F.R.S., &c.

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14. "On Comparative Observations of Solar Radiation." By Rev. F. W. Stow, M.A., F.M.S.

15. "On the Meteorology of England during the Years 1867 and 1868." By James Glaisher, Esq., F.R.S., &c.

16. "On the Rotation of the Wind between oppositely directed Currents of Air in the Southern Indian Ocean." By Charles Meldrum, Esq., M.A., F.M.S.

17. "The Influence of the Moon on the Amount and Frequency of Rainfall, as dependent on her age." By James Glaisher, Esq., F.R.S., &c.

18. "On the Meteorology of Earthquakes." By R. J. Mann, Esq., M.D., F.R.A.S., F.R.G.S., F.M.S.

19. "On the Influence of the Moon upon the Fall of Rain in respect to her Age." By George Dines, Esq., F.M.S.

20. "On the Rainfall of Mauritius." By M. Connal, Esq., C.E. (Communicated by Prof. Newton).

21. "On the Ozonometer for the observation of Ozone with an Aspirator, Instructions for its Use, and the Results obtained." By John Smyth, jun., Esq., M.A., F.M.S., M.I.C.E.I.

22. "On the heavy Snowstorms of the Winter 1868–69, in the Province of Quebec, Dominion of Canada." By Charles Smallwood, Esq., M.D., LL.D., D.C.L., Professor of Meteorology in the University of M^{c}Gill College, and Director of the Montreal Observatory.

23. "On the Connexion between the Relative Positions and Directions of Air-currents and the Barometric Pressure in the Southern Indian Ocean." By Charles Meldrum, Esq., M.A., F.M.S.

24. "Weather-Signs, as to Temperature." By F. W. Doggett, Esq., F.M.S.

25. "Weather-Signs, as to Rain." By F. W. Doggett, Esq., F.M.S.

26. "On the Height of the Barometer in relation to the Direction and Force of the Wind, at London." By Richard Strachan, Esq., F.M.S.

Resolved:—

That the Report just read be received and adopted, and that it be printed and circulated among the Fellows of the Society.

Proposed by G. J. Symons, Esq.
Seconded by Rogers Field, Esq.

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The President having appointed W. J. Harris, Esq., and L. P. Casella, Esq., as Scrutineers, a ballot was then taken, and the following list of Members, prepared and proposed by the retiring Council, was received and adopted as Council and Officers for the twenty-first Session, 1869–70:—

THE OFFICERS AND COUNCIL

OF

THE METEOROLOGICAL SOCIETY,

ELECTED 16TH OF JUNE, 1869.

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The Treasurer's Account for the year 1868.

Receipts.

1868.		£ s. d.	£ s. d.
Jan. 1.	To Balance of last year	.....	14 0 2
April.	Dividend on £1000 New 3 per Cents	14 12 6	
Oct.	Do. do. do.	14 12 6	
	DIVIDENDS	29 5 0	

		£ s. d.		
	Subscriptions for 1865	2 0 0		
	Do. for 1866	4 0 0		
	Do. for 1867	14 0 0		
	Do. for 1868	174 2 0		
	Do. for 1869	6 0 0		
	SUBSCRIPTIONS	200 0		
June 17.	R. L. Holmes, Esq.	10 0 0		
„ 30.	Rev. Ch. J. Steward	10 0 0		
Dec. 10.	A. S. Hobson, Esq.	10 0 0		
	COMPOSITIONS	30 0 0		
			230 2 0	
			£259 7 0	
Dec. 31.	Sales of Proceedings, &c.		12 12 6	
	RECEIPTS			271 19 6
				£285 19 8

1869.		
Jan. 1.	To Balance	£27 8 9

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The Treasurer's Account for the year 1868.

Expenditure.

1868.			£	s.	d.	£	s.	d.
Jan. 15.	By Proceedings,	No. 34	28	5	5			
Feb. 19.	Do.	No. 35	25	1	0			
Mar. 18.	Do.	No. 36	21	2	0			
April 15.	Do.	No. 37	17	7	0			
June 17.	Do.	No. 38	29	2	9			
Nov. 18.	Do.	No. 39	21	11	3			
	PROCEEDINGS, Six Nos.					142	9	5
June.	Registrar-General's Reports		2	16	0			
Dec. 31.	Do. do.		2	16	0			
						5	12	0
	PRINTING					148	1	5
	Stationery		9	8	0			
	Postage Stamps		9	15	0			
	Petty Expenses of Librarian		1	3	5			
	Advertisements in 'Athenæum' and 'Times'		0	17	0			
	Attendance and Refreshments		7	16	6			
	EXPENSES					28	19	11
	Assistant to Editor of Proceedings		52	0	0			
	Collector's Commission		10	0	0			
	SALARIES					62	0	0
	Seal, Dies, and Appurtenances		9	11	6			
	Books for Library		1	5	4			
	Binding Books		7	2	9			
	Two Boxes for Books and Papers		1	10	0			
						19	9	7
	PAYMENTS					£258	10	11
Dec. 31.	BALANCE					27	8	9
						£285	19	8

HENRY PERIGAL, *Treasurer.*

W. C. NASH, *Auditor.*

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Resolved:—

That the cordial and best thanks of the Meteorological Society be communicated to the Council of the Institution of Civil Engineers for having granted the Society free permission to hold their Meetings in the rooms of the Institution during the Session that has just ended.

Proposed by Dr. Mann.
Seconded by Dr. Tripe.

That the best thanks of the Society be given to the retiring President, James Glaisher, Esq.

Proposed by Dr. Tripe.
Seconded by Dr. Mann.

That the best thanks of the Meteorological Society be given to Dr. Tripe for his services during the past year.

Proposed by F. W. Doggett, Esq.
Seconded by Dr. Hering.

That the cordial thanks of the Society be given to the Treasurer for his excellent service to the Society during a period of sixteen years.

Proposed by Dr. Mann.
Seconded by G. Dines, Esq.

NOTICE.

Session 1869–70.

The Meetings will be held on the Third Wednesday in the months, at 25 Great George Street, Westminster, S.W., by the kind permission of

The Council of the Institution of Civil Engineers.

Ordinary Meetings at 7 P.M.

1869.	November	17	1870.	March	16
1870.	January	19	„	April	20
„	February	16	„	June	15

The Annual General Meeting will be held after the Ordinary Meeting on June 15.

Council Meetings at 6 P.M.

1869.	October	20	1870.	March	16
„	November	17	„	April	20
1870.	January	19	„	June	15
„	February	16	„	October	19

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